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THE MONTH OF CONVENTIONS.

June has generally been considered the month of weddings, but judging by the present year it should more properly be reckoned the month of engineering conventions. The American Society of Mechanical Engineers has already met and adjourned at Niagara, the National Electric Light Association meets in Chicago June 7, 8 and 9, and the Northwestern Electrical Association has thoughtfully arranged its attractive combination of lake excursion and convention to leave Chicago the next day. Later in the month the American Institute of Electrical Engineers will assemble at Omaha, and on the same days, namely, June 27, 28 and 29, the Canadian Electrical Association will convene in Montreal. The information given out at these various conventions in the way of data obtained from personal experiences, conclusions drawn by the leaders in the various lines of electrical work and suggestions of new ideas, will make a notable advance in the annals of electrical engineering. THE ELECTRICAL WORLD will, for the benefit of those who do not attend the conventions, publish this wealth of valuable information as promptly as possible.

LIGHTNING ARRESTERS.

The use of better materials in electrical work, paradoxical as it may seem, has undoubtedly increased the trouble from lightning. A poorly insulated circuit, such as suffices for 110 or 220-volt work allows plenty of opportunities for static charges to leak off or discharge to the ground, but the higher grades of dielectrics and the care taken in the insulation of high tension apparatus keep such circuits so well separated from the ground that the lightning has to break down something to find a path. As pointed out by Mr. H. E. Raymond in another column, it is customary to protect (?) machines of 500 volts or less with lightning arresters requiring perhaps 5000 or more volts to discharge across the air gap within them. It is impossible to adjust the gap of an arrester with precision to any desired discharge voltage, as, for example, the safety valve of a steam boiler can be adjusted. This is due to the fact that commercial voltages only jump very minute air gaps, and these cannot, of course, be finely adjusted. Conditions such as moisture, dust, etc., also affect the discharge voltage of these extremely short gaps. If some substance, either liquid or gaseous, could be found having a much lower dielectric strength with a high ohmic resistance and capable of restoring itself after break down, as does an air gap, it would give a far more finely adjustable and dependable lightning arrester.

Lightning discharges are now recognized to be, frequently at least, of an oscillatory character, and although the frequency of the oscillation is hard to determine it appears to be comparable with that of discharges producing Hertz waves. Choking coils are used to cut the discharge off from the machines by their self-induction, but it is more than likely that this ironless self-induction, combined with the electrostatic capacity of the machines beyond them, may act to attract by resonance the discharge into the machines rather than to keep it out. The vagaries of lightning indicated in the time-worn saying that "lightning never strikes twice in the same place" are probably due to this oscillatory action, with different frequencies at every discharge and the various resonance periods of different discharge circuits.

The use of ohmic resistance to shorten the air discharge gap is suggested in the article referred to above. In the power plant of the New York & Staten Island Electric Company, also described in this issue, there is used a special water rheostat inserted without any discharge gap straight across from the bus bars of the railroad system to the ground. Just how low such a resistance should be, or, in other words, what resistance in ohms will take off the lightning discharge as readily as an air gap of a given fraction of an inch, is a question well worth studying.

GAS ENGINES FOR DYNAMO DRIVING.

While the use of gas engines for the driving of electric generators has been strenuously advocated for the last few years the practice has made but the slightest progress in this country. It is generally recognized that the internal combustion engine is more economical of fuel than any steam engine, and this one consideration has caused a considerable use of gas engines in England and Continental Europe, in spite of their disadvantages. Internal combustion engines in this country are universally fired with petroleum products or illuminating gas, while in England special gas producers are used, reducing the cost of fuel below that of illuminating gas, owing to the non-necessity of purifying the product. In this way a fuel economy is obtained that would startle an American central station engineer. For example, one English central station is on record as having generated 650 watt hours at the switchboard per pound of coal consumed. This is quite different from the figures customarily obtained here, varying from 150 to 300.

No up-to-date electrical engineer will now install belted machinery, and the gas engine, to be successful, must be suitable for direct coupling to the generator. The most widely used type of gas engine is built with single-acting cylinders operated on what is known as the four-stroke cycle, wherein one effective power-producing stroke is followed by two idle strokes and one power absorbing stroke. The governing is customarily effected by missing effective strokes, thereby reducing the relative frequency of the power-producing strokes to one out of eight strokes at half-load; one out of sixteen at quarter-load, etc. This gives, even with fly wheels far heavier than those in use on steam engines of the same power, variations of speed prohibitive in most electrical work. With a storage battery, which serves as a sort of electrical balance wheel with an enormous equivalent moment of inertia, such direct-coupled generators can be run, but without the storage battery it is imperative that the engine should at least give one active stroke every two revolutions, and should therefore govern by varying the fuel per cycle. Several such engines are now in commercial use, the difficulty found with them being the quick fluctuation or kick of the speed caused by the high pressure compression and the still higher pressure expansion immediately following, with the thin indicator diagram necessary to high economy in gas engine work.

A quick variation of 2 per cent. causes a disagreeable flicker in 3.1-watt incandescent lamps. One per cent. is detectable and one-half of one per cent. is negligible. It is practically impossible to obtain a maximum variation of the speed during the cycle as low as this with single-cylinder four-cycle engines without the use of abnormally large wheels. With dynamos belted to such engines by link belts run very slack, and carrying a fly wheel on the dynamo shaft, this quick kick of the engine speed will be smoothed out, so to speak, by the give of the slack belt. Another ingenious but rather unscientific method of accomplishing the same purpose is the use of a slipping coupling with considerable fly-wheel capacity on the dynamo side. Another possible method of accomplishing the same result is the use of a coupling, flexible in such a way that the dynamo and engine shafts can turn relatively through a considerable angle, say 180 degrees or more, without materially increasing the torsion in the flexible connections. Such a coupling might be made with a powerful steel spiral spring much like a mammoth watch or clock spring. This would give greater flexibility than the belt arrangement and eliminate the power loss and wear of the slipping coupling.

The gas engine without a producer has an enormous advantage over the steam engine in that there is no boiler with its necessary attention, danger and losses. In small isolated plants and central stations giving only a night service the fuel consumption per unit output is greatly increased by the fuel burned before the plant starts at night and after it stops in the morning. The gas engine requires, perhaps, a pound or so of fuel to get it under way, and need not burn an ounce after the load is removed.

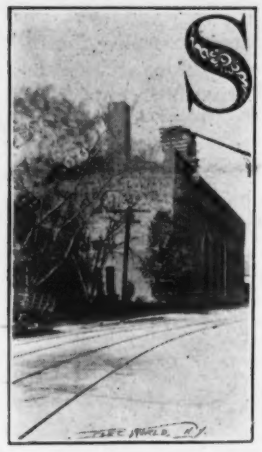
MULTIPLE SERIES ARC LAMP CIRCUITS.

In another column of this issue appears a description of the lighting plant of the Missouri Edison Company, St. Louis, Mo. One of the most interesting features of this plant is the change now being effected from continuous current supply for the arc circuits on independent machines to alternating current supplied from one large generator, or a battery of generators in multiple. The lines remain the same as before, series circuits, and even the same lamps are used with a proper change of regulating cores and coils, but instead of being supplied by a wasteful battery of small inefficient series machines driven through power consuming belts and countershafts, the various series lines are put in multiple on one large multiphase or monocyclic fly-wheel generator direct-coupled to its driving engine. The gain in economy of fuel per kw hour at the switchboard will naturally be very great, probably 30 or 40 per cent. The depreciation, breakdown and maintenance repairs and cost of attendance of the new type of generating plant is probably about one-half that of the old. What the relative amount of light obtained per kw hour may be is an interesting question. It will naturally be less than that of the direct-current arc, but not sufficiently less in all probability to offset any material part of the great gain in the station.

COMBINED RAILWAY AND LIGHTING POWER STATIONS.

In another column will be found a description of an electrical generating plant supplying current for both railway and lighting service. This combination is rare in this country, although more frequently found in England. That it has great advantages financially has been pointed out by Mr. A. E. Lang, who should certainly know whereof he speaks, as he is the president of a company operating such a system. He states that to increase the earnings "no better method can be found than by consolidating under one roof all electric power apparatus, where the conditions are favorable." This may seem surprising where, as is the case in this country, railway and lighting apparatus is quite independent, except that the engines are supplied by the same battery of boilers. Some foreign stations are equipped with motor generators connecting the two systems together, so that the dynamos and engines of either one or the other may be shut down at times of light load. This undoubtedly improves the conditions, but a more nearly ideal system would be one in which the power for both services would be generated in the same machines. With the present tendency toward high-tension multiphase generators and rotary transformers for railway work and high-tension multiphase generators and stationary transformers for lighting work, this combination will soon come as a matter of course. The improved load factor and the reduction of almost every item of the cost per kw output, owing to the increased sizes of all parts of the plant, should cut down the expense of generation considerably.

Power Plant of the New York & Staten Island Electric Company.



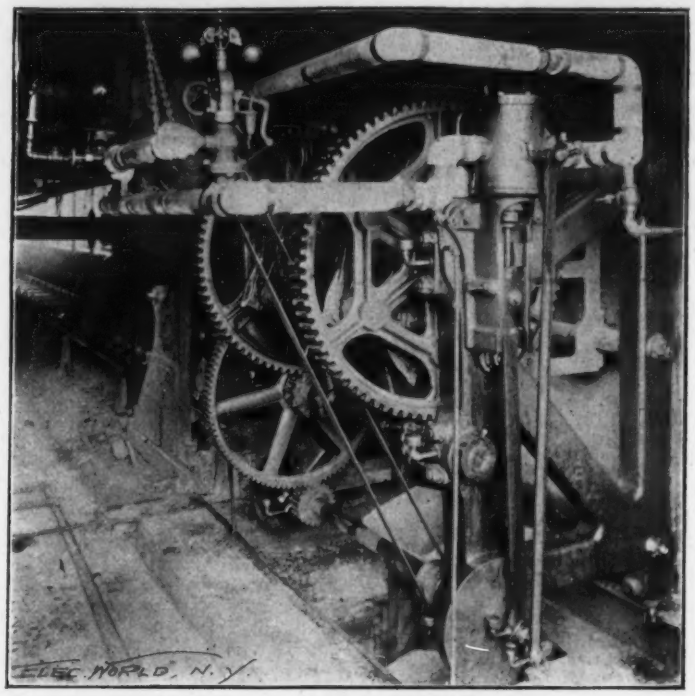
STATEN ISLAND, which, since January 1, has become the Borough of Richmond in the city of New York, is undoubtedly destined to become one of the largest "bed rooms" of the metropolis. Fifteen miles in length, with an area of some 50 or 60 square miles, its nearest point within 5 miles of the business centre, the population will undoubtedly grow from the present figure of some 70,000 to ten times that number in a few years.

All electric current used for the lighting service on the whole of the island, and the greater part of the electric power used for traction purposes, is now generated in a new station recently built by the New York & Staten Island Electric Company on the shore of the Kill von Kull in Livingston, at the north end of the island. This station replaces three power stations which were originally built by various companies, of which the New York & Staten Island Electric Company is the consolidation. Work was commenced on the building by the Electric Power Company of Staten Island in the summer of 1892, but the company soon after went into the hands of a receiver and work was then abandoned until taken up by the new company early in 1897.

The general layout of the station comprises a roomy and lofty dynamo room some 155 by 65 feet in size, and lighted by high-arched windows on two sides, with a switchboard gallery running the whole width at one end, and a handsome suite of offices built over the driveway and overlooking the main engine room through a window

THE BOILER ROOM, SHOWING OVERHEAD BUNKERS.

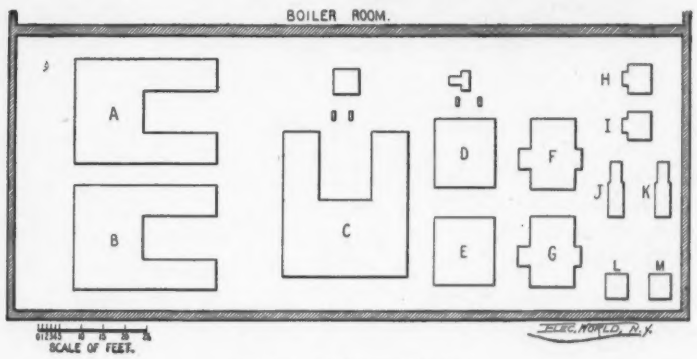
above the switchboard. Adjacent to the engine room, on the long side facing the railroad and the water front, is the boiler room, with a square brick stack with a 9 by 9 foot flue, 165 feet high, at one end. This stack is lined for half its height with firebrick, the inside and outside layers being entirely independent, so that they can slide one past the other in expanding or contracting. Next to the stack is what might be called a "porte-cochere" for railway cars, spanning a spur of the Staten Island Rapid Transit road. Under this is a hopper into which the contents of coal cars can be dumped and overhead are two other hoppers for ashes, one serving the rail-



THE CONVEYOR DRIVING ENGINES.

road cars and the other serving a spout by which the ashes can be shot into box cars on the electric road and hauled away for use in track construction and maintenance.

The general layout of the station comprises a roomy and lofty bucket conveyor installed by the C. W. Hunt Company. The coal is spouted from the hopper under the railroad track direct to the buckets and carried by them up and over a U-shaped bunker immediately over the fire room. This bunker is about 9 feet wide and 12 feet high and 125 feet long and will hold 360 tons of coal. The buckets may be dumped at any point over this, after which they run on and down below the fire room floor where the ashes may be shoveled into them to be carried up and over the ash hoppers mentioned above. From this point the buckets run down again below the coal hopper completing the circuit. A 1000-ton bunker is to be built later on the dock, and the conveying apparatus is to be extended over the tracks to connect therewith. A steam shovel will be installed to dip out the coal from canal boats or other craft. Anthracite buckwheat is the fuel used exclusively. From the bunker over the fire room hang five chutes balanced on Howe scales, reading to zero when the chute is empty. On every filling the weight is balanced on the scale and recorded



PLAN OF ENGINE ROOM.

A and B.—400 Kw Railway Generators. C.—800 Kw Railway Generator. D and E.—300 Kw Triple Expansion Alternators. F & G.—300 Kw Compound Alternators. H and I—Exciters. J and K.—Engines Driving L and M.—160 Light Arc Dynamos.

and the chute then emptied on the floor in front of the corresponding furnaces.

The boiler plant consists of ten B. & W. type boilers built by the Aultman & Taylor Company, Mansfield, Ohio, each rated at 330 horse-power. Back of the boilers the flue gases are carried to the

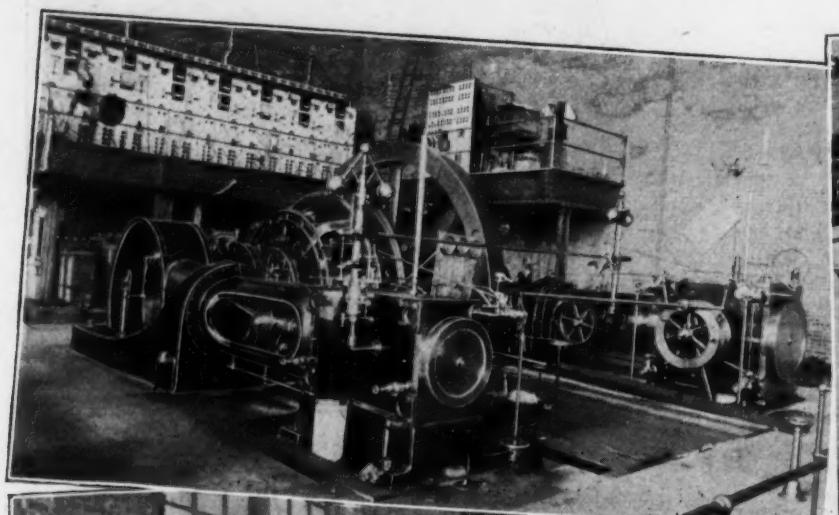
stack by a chamber about 5 feet wide and 5 feet high at its smaller end. The upper side of this is about on a level with the steam drums, the lower side sloping downward toward the stack. The boilers are supplied with feed water by two Worthington duplex pumps, and will be later equipped with the Parsons blower, dumping grates and automatic damper regulators. Over the boilers and running their whole length is a 12-inch steam header. This is connected to the nozzle of each boiler by an 8-inch branch running vertically up from the nozzle, then over to a point above the header and then downwardly into it. This is connected at four points to an auxiliary header of the same size, located below the floor level behind the boilers. Still another auxiliary 6-inch header is run part of the length under the engine room giving, with suitably arranged valves, a combination whereby the failure of any one length of piping will not shut down any engine. All steam piping is extra heavy, and all piping and wiring is carried below the floor level, this leaving the engine room clear of obstructions to the movement of the 15-ton hand crane, which runs overhead the whole length of the room. Above the crane is a steel roof built by the Berlin Iron Bridge Company, and fitted with its anti-condensation lining.

The generating units for the railway system consist of the following: One 1200-hp 24-inch and 48 inch x 48 inch horizontal cross compound Allis Corliss engine, with an 800-kw multipolar Walker generator mounted on its shaft: two 750-hp 18-inch and 34 inch x 42 inch horizontal cross compound Allis Corliss engines, with a 400-kw General Electric generator mounted on the shaft of each. These two machines were moved from the old station of the Staten Island Electric Railroad Company. For the incandescent lighting service there are four 300-kw Stanley two-phase inductor alternators, two of which are mounted centrally on the shafts of two McIntosh & Seymour vertical cross compound 16 and 32 x 24 inch engines, rated at 600 horse-power each. The other two are similarly mounted on the shafts of four-cylinder two-crank triple-expansion engines of the same make, two cylinders being mounted steeple fashion on each crank.

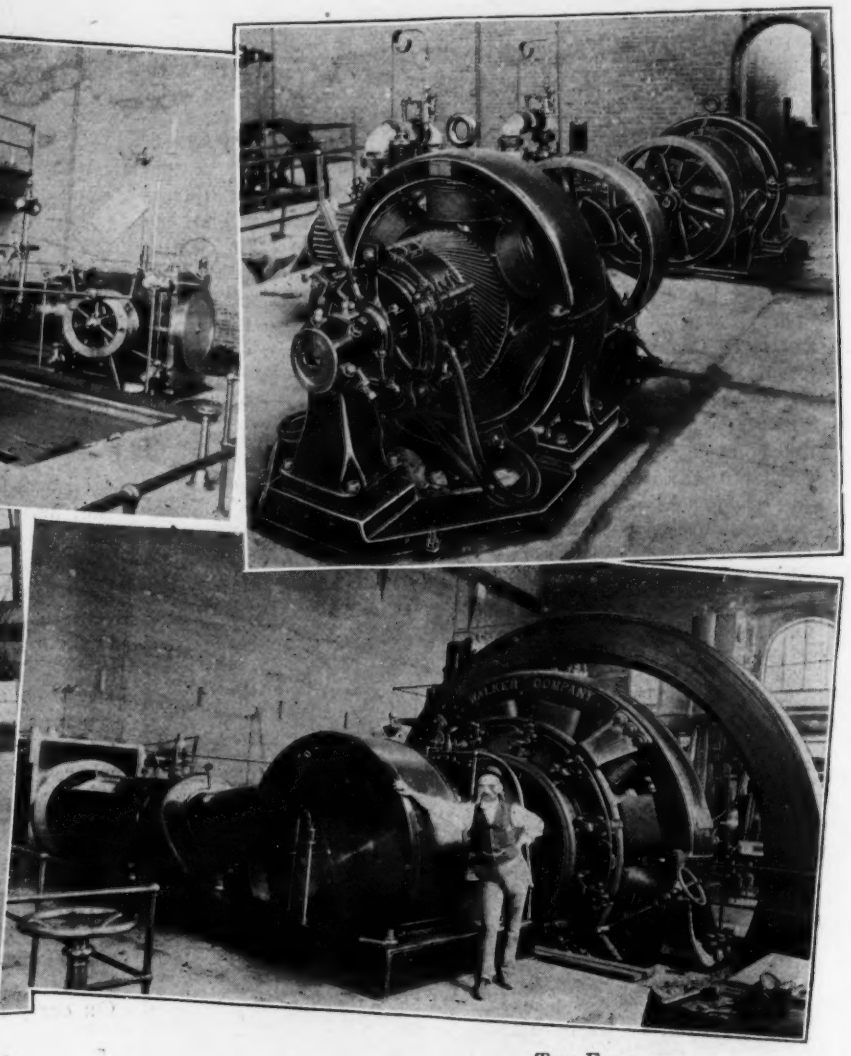
For exciting the direct-coupled alternators two 20-kw four-pole 60-volt Onondaga dynamos are direct coupled to simple horizontal 7 x 8-inch Erie Ball engines, rated at 40 horse-power each For the arc lighting service there are two 160-light 6.7-ampere four-circuit Brush arc machines, each belted to a horizontal tandem compound Erie Ball engine, rated at 125 horse-power, with cylinders 9 and 16 x 12 inches, and running at 300 r. p. m.

The engines are run condensing, the steam being passed on its way to the condensers through Wheeler feed water heaters, of which one is provided for each of the railway generators and one for the two compound McIntosh & Seymour engines. Jet condensers are used exclusively, Allis combined condensers and fly wheel air pumps being used for most of the engines, one Worthington vertical twin combined air pump and condenser taking the exhaust from one pair of the vertical compound engines. Salt water from the Kill von Kull is distributed to the condensers by a 20-inch main. Wells have been driven below the station from which water for the boilers will eventually be taken. Alll the feed water after passing the Wheeler heaters mentioned above is taken to a Holly settling tank purifier and live steam heating apparatus, by which it is heated to a temperature of about 250 degrees before entering the boilers. All the steam pipes are dripped, the headers being tapped every 15 or 20 feet, and the drip is returned to the boilers by the Holly gravity return.

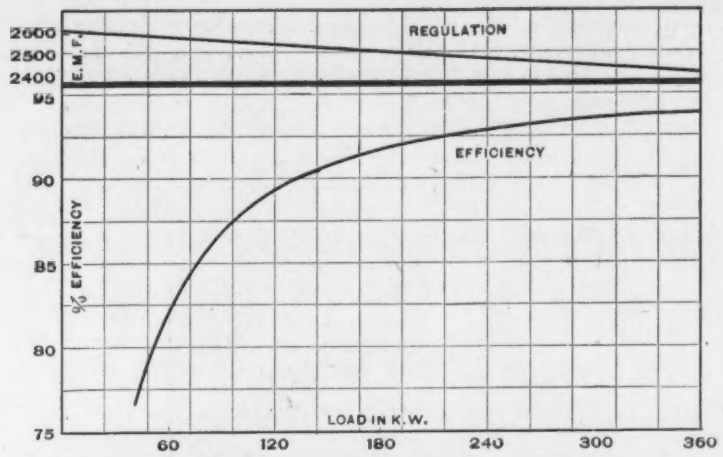
One of the most interesting features of the plant is the floor of the main room. This is of the Ransom fireproof type, and consists simply of concrete girders and a floor integral with each other formed on a falsework of wooden boxes, afterward knocked out



One of the 400-kw Railway Generators.
A 160-Light Arc Machine and Engine.



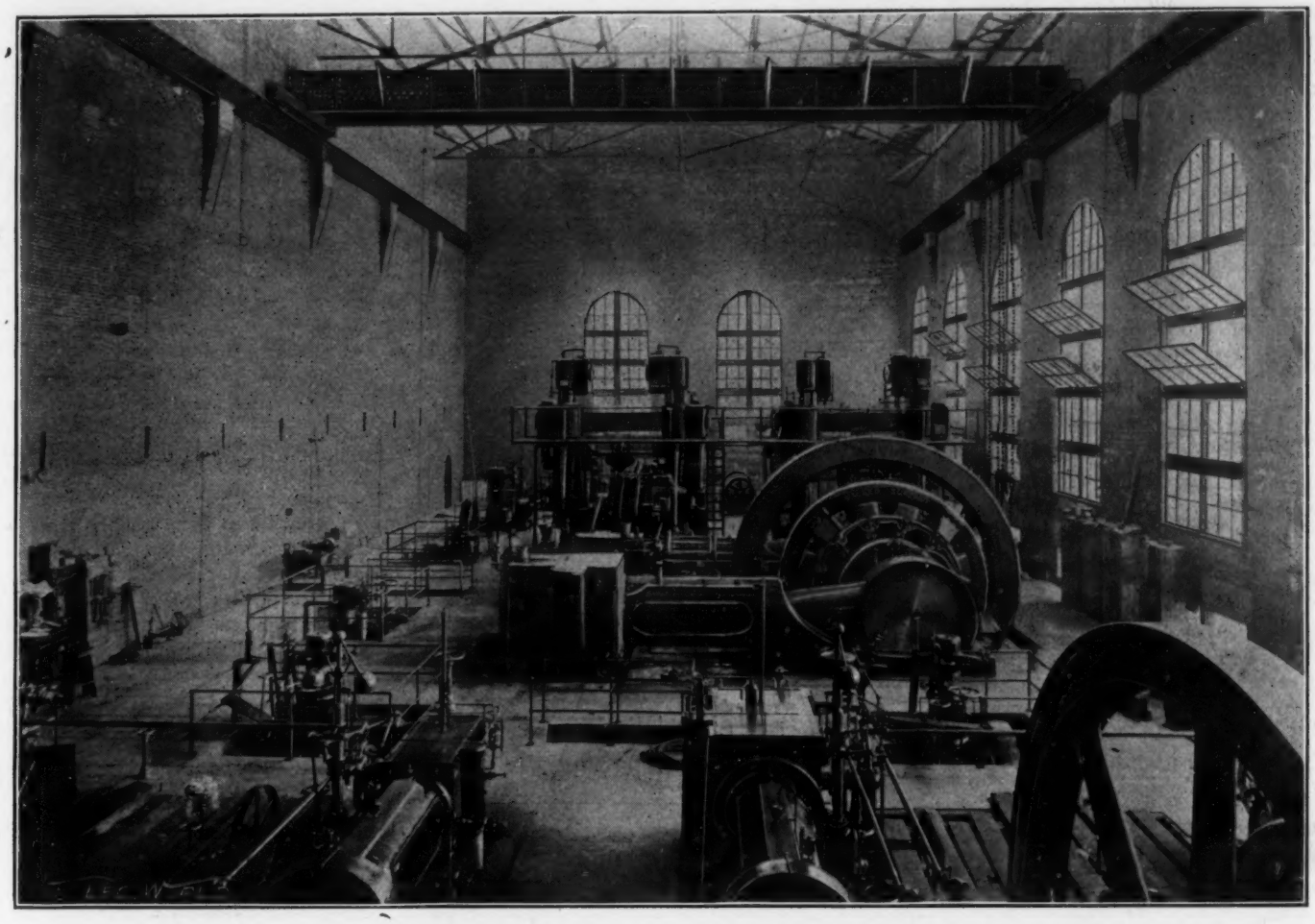
The Exciters.
The 800-kw Railway Generator.



EFFICIENCY AND REGULATION CURVES OF 300-KW INDUCTION ALTERNATOR.

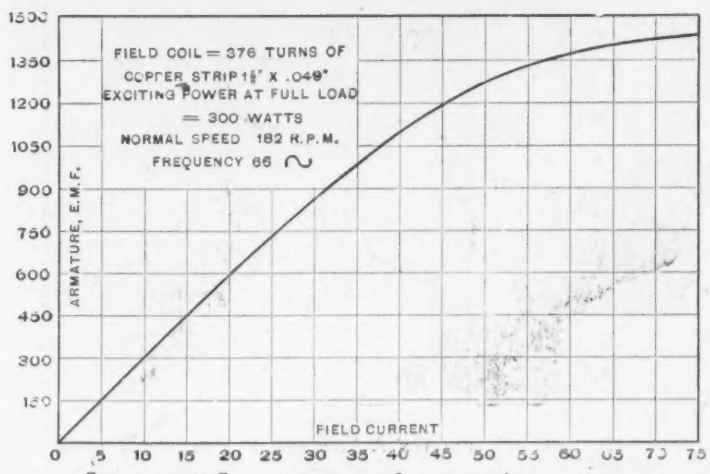
foundations, rendering the whole structure almost as stiff as a masonry block, taking out all vibration from the engine bases. The foundations, by the way, are of brick, carried down to gravel, with a sub-base of concrete 6 feet deep, 18 inches larger than the brick pier all around. The building foundations are on piles capped with masonry, the stack foundation being of granite stepped out to a base of 40 feet square.

Of the railway apparatus there is very little out of the ordinary run of modern standard practice. The switchboard is of polished slate, built by the General Electric Company, and equipped with its standard apparatus. There are ten feeder panels, three generator panels and one instrument panel, with totalizing ammeter, bus-bar voltmeter and machine voltmeter. This panel is arranged at one end on the main board and in front of the latter, turned in such a way that the instruments can be seen from any point of the board. One special feeder panel connects the bus-bars through a large water rheostat to ground. This is thrown in circuit when thunder storms come up, and is said to make a very efficient lightning arrester.



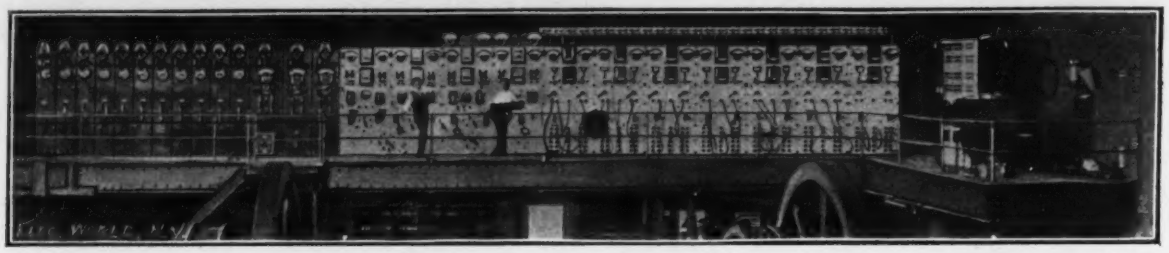
GENERAL VIEW FROM THE SWITCHBOARD GALLERY.

from below. The girders are run as a rule from the building to the engine foundations, but three special piers being used under the whole structure. Some of the main girders thus have a 22-foot span. The main concrete beams are about 22 inches deep by 10 inches in width at the top, tapering to 8 inches in width at the bottom. They are conneceted by smaller lateral concrete beams 10 inches deep and tapered from a width of 4 inches to 3 inches. In the bottom of these girders there are placed twisted square iron bars about 1 inch by 1 inch in cross section. These were simply laid in the concrete, in which they are firmly imbedded, thus taking the tensile stresses. The floor itself contains a grillage of ¼-inch twisted bars in two layers crossing each other, the total thickness of the floor being some 4 inches. The beams and about 3 inches of the floor are made up of concrete with 1 inch to ½ inch broken stone finished off with a layer of small stones and a surface layer of neat cement. This floor, which is guaranteed to carry 400 pounds to the square foot, with a factor of safety of five, was constructed by Mr. Joseph Sharpe, of Paterson, N. J.. It constitutes a perfect system of rigid ties between all the engine foundations and the building's



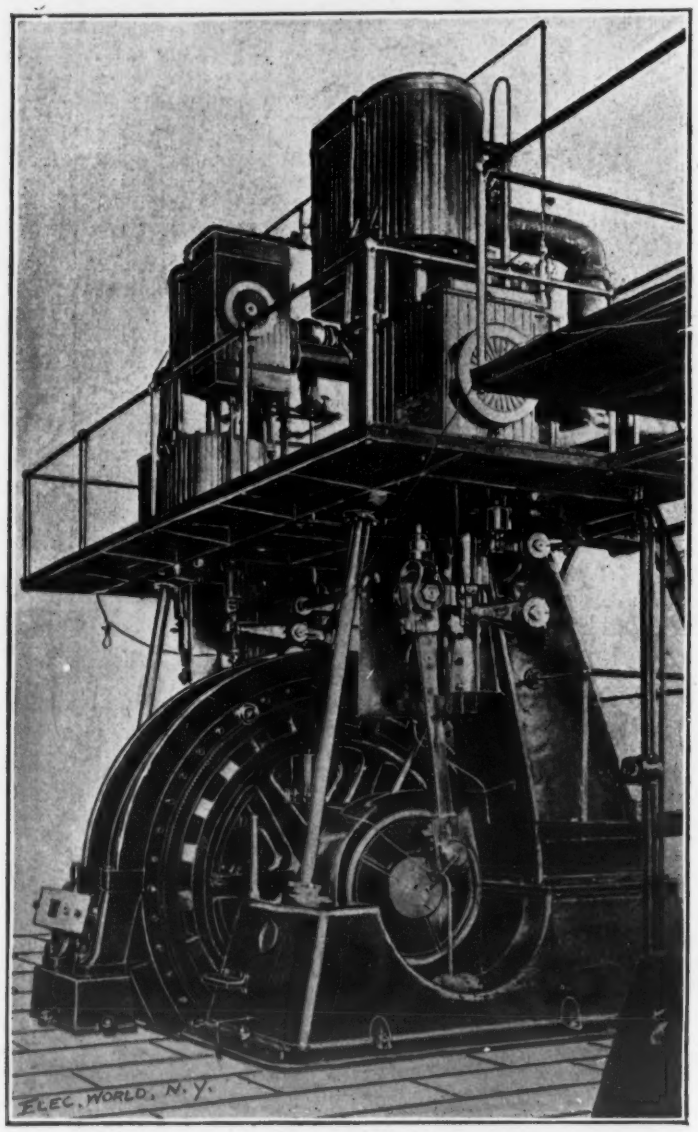
SATURATION CURVE OF 300-KW INDUCTOR ALTERNATOR.

The most interesting equipment of the whole station is the alternating current two-phase system. The dynamos, running at 182 r. p. m., give current at 60 cycles and can be connected up for 2400 volts in each phase. The inductor is divided in such a way that the ring of north poles can be separated from the ring of south poles and either one slid along the shaft exposing the coils of the stationary armature. The top half of the fields can be lifted off, if necessary. At the switchboard one terminal of one phase of each machine is connected to one terminal of the other phase of the same machine, giving a three-wire two-phase system. What might be termed a regulating lead is tapped off from each phase with 10 per cent. of the active winding between it and the outside terminal of that phase. This gives what amounts to a five-wire two-phase system, with 10 per cent. of the machine voltage for regulating purposes between the two outside terminals of each phase. Two sets of five bus bars are carried the whole length of the A. C. board.



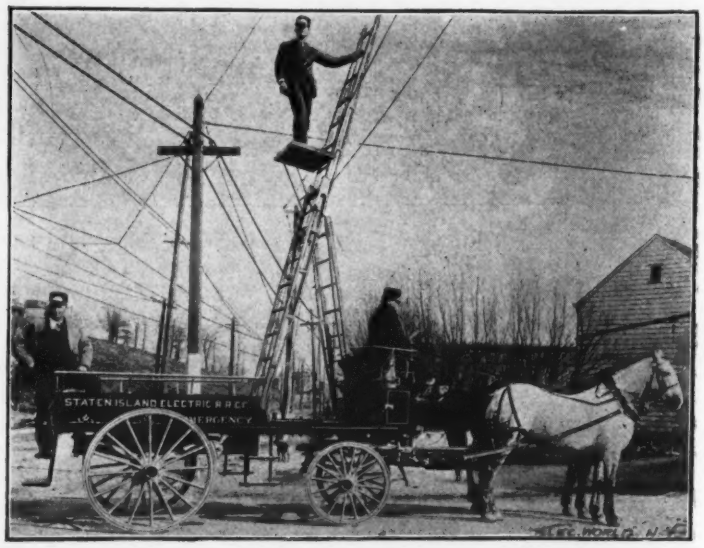
The Switchboard Gallery.

This board is of white marble, and was built by the Stanley Electric Manufacturing Company. It is some 38 feet in length by 90 inches in height, and contains four generator panels and seven feeder panels, each capable of handling one three-wire two-phase or two single-phase feeders. The generator panels each carry two indicating ammeters, two static voltmeters in glass cases and taking the full line pressure, and two ground detectors. One instrument of each of these pairs is, of course, in each phase. Below these are Thomson integrating wattmeters, one for each phase, a direct-current indicating ammeter in the field circuit and two three-pole double-throw quick-break switches, with all contacts on the back of the board, the switch being operated by a rack and gear attached to the handle in front. The switches have a capacity of 150 amperes and are arranged to cause a simultaneous break at six points of the circuit. Four of these breaks are fitted with enclosing boxes for rupturing the arc.



Triple Expansion Alternating Unit.

The panels are also provided with field rheostats, field switches and exciter-controlling mechanism and synchronizing lamp All live conductors are on the back of the board, and the holes through which they are bolted are covered in on the front with hard rubber caps. The seven feeder panels are fitted with feeder ammeters, circuit breakers, S. K. C. lightning arresters and ground detectors. Lower down are three-pole double-throw switches to throw the feeders from one set of bus bars to the other, and a set of flexible cables, plugs and cable receptacles, and of regulating switches. The regulation is accomplished as follows: Each feeder has a small auto-transformer connected across the 10 per cent. regulating voltage mentioned above. This auto-transformer is tapped out at several points to the points of the regulating dial, and the feeder is connected to the proper contact to give the desired amount of boosting. The plug and cable system also involves some new features. One of the plugs on each cable screws into the switch receptacle; at the other end there is a conically tapered end connection which is ground to fit the stud in the bus bar receptacle and arranged to be locked to it by a bayonet joint. Receptacles are provided for five sets of five-pole bus bars, but only two sets are used, as the machines are reguarly worked in parallel, and with one set in use one reserve set is all that is necessary.



Emergency Wagon.

The arc board is of white marble, built by the General Electric Company, and fitted with a complete plug and receptacle system for the handling of three four-circuit machines. The Brush arc machines are, however, used as two-circuit machines, two of the external circuits being simply short circuited in order to throw the

full voltage of the corresponding windings on to the next circuits. This gives 4000 volts across the lines when the machines are loaded, the total voltage of the machine being 8000. No trouble has been experienced from insulation breakdown. The board is fitted with two lightning arresters in series in place of one, on account of the high tension. The arc machines are equipped with the new magnetic clutch, the regulator operating the field shunt and moving the commutator brushes. An addition to the station is already being erected for the installation of more arc machines.

The wires are carried from the machines to the switchboard in a wire runway below the floor, built of angle and channel irons. The arc and incandescent circuits are carried on 5-inch Locke triple-petticoat insulators, and the railway circuits through split porcelain sleeves. The outside distribution is entirely overhead, the wires running up to a wire tower with slate walls and holes bushed with porcelain, the lines being fastened to insulators both inside and outside the walls to relieve the bushings of any strain. Most of the alternating-current lines are as yet single-phase, being simply tapped off from either side of the two-wire system, but some three-wire two-phase circuits are run and a motor load is being developed. Stanley two-phase motors are used, the largest machine being of 30 horse-power, used in the works of the C. W. Hunt Company.

The arc-light circuits are run only in the northern part of the island, but the southern end as far as Tottenville—16 miles, as the wires run—is fed by a 2400-volt A. C. circuit. Wherever arc lights are needed in this part of the island they are put on the alternating lines, some twenty-four alternating enclosed lamps being used. Many miles of the streets are lighted by 25-cp incandescent lights, of 110 volts each, connected in series circuits, with shunt boxes around the lamps. The long-distance transmission to the southern end of the island will soon be changed over to 6000 volts, obtained by step-up transformers at the station, the drop being too great with the present system. The same high tension lines will supply power to the two popular beaches on Staten Island. These beaches, which require at the present time some eighty arc lights and many hundred incandescents, serve admirably to keep up the annual load curve, the peak of the whole station output in summer being about as high as in winter. The two beaches are about 1 mile apart, and will be supplied with alternating current by the high-tension lines mentioned above, feeding 1000-volt secondaries, through two 75-kw transformers located midway between the two centres of distribution. These beaches also serve to give a load of no mean proportions to the street railway system. This system comprises some 40 miles of track (single track measurement), equipped with seventy cars, forty-five of which are open and twenty-five box cars. All the cars are equipped with G. E. 800 motors. The car barn has twenty tracks, with a capacity of five cars each, the track level being raised above the floor level, thus giving a continuous general pit.

A few ingenious features are used, one of which is a piece of knock-down track, on which a car can be run and blocked up, the track promptly removed and wheels replaced in a much shorter time than if it were necessary to jack up the car body. Another is the emergency wagon shown in the accompanying illustration. This weighs but 650 pounds, and carries a collapsible extension ladder mounted on a sort of revolving platform on the wagon.

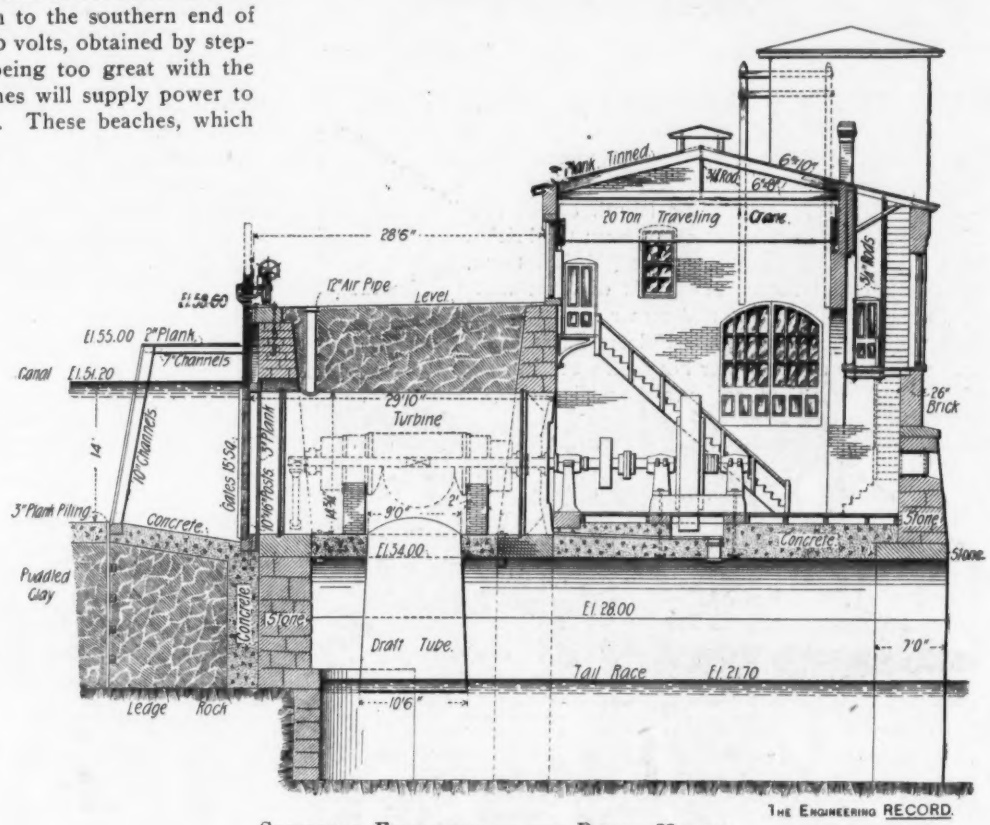
Some of the officers of the New York & Staten Island Electric Company are: Col. G. B. M. Harvey, president; Hon. E. P. Doyle, vice-president; Mr. S. F. Hazelrigg, general manager; Mr. S. B. Libby, who planned and constructed the line distribution, superintendent. Mr. W. H. Brenner is the constructing engineer who laid out a large part of the system described above, Mr. W. S. Austin having succeeded him on his recent departure for Japan.

Power Plant of the Columbia Water Power Company.

THREE notable developments of water power in South Carolina have within the past two or three years been successfully put in service, and by means of electricity the power of three rivers is now utilized to drive thousands of spindles in the great cotton mills which nave recently sprung up in their vicinity, to light the residences of the managers and the operatives, and to drive the street cars and illuminate the streets of the small towns which have grown like mushrooms around the mills.

The three rivers are the Seneca, the Saluda and the Broad. At Anderson, S. C., the power of the former is now exploited by the Anderson Water, Light & Power Company. The power of the Saluda is utilized by the Pelzer Manufacturing Company, of Pelzer, S. C., and that of the Broad by two concerns, the Columbia Mill Company and the Columbia Water Power Company, at Columbia, S. C. The installations at Anderson, Pelzer and that of the Columbia Mills have already been described and illustrated in these pages. The installation of the Columbia Water Power Company is the latest, and includes a development of 3000 horse-power, which is to be ultimately increased to 10,000 horse-power.

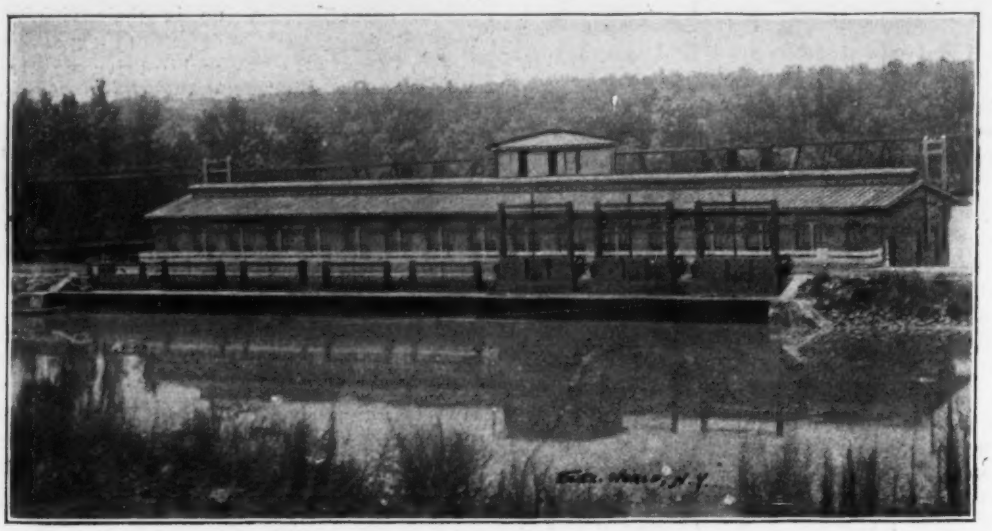
The power house is erected on a narrow strip of land separating a canal 3 miles long, 110 feet wide at the bottom, 150 feet wide at the top and 12 feet deep from the river. This canal was built some ninety years ago by the State around the falls of that river to facilitate communication between the uplands of South Carolina and Charleston and Georgetown. It was abandoned when other modes of transportation became more readily available, and was recently acquired by the Columbia Water Power Company for use as a head race. The maximum difference in level between the water in the canal and the river surface is about 31 feet; the grade in the canal is 1-foot to the mile, giving a flow of water of about 4830 cubic feet per second. The maximum power available is calculated to be 14,000 horse-power, under an average head of 31 feet. To secure this power a timber dam 1200 feet long was thrown across the Broad River just above its confluence and arched up



SECTIONAL ELEVATION OF THE POWER HOUSE.
Courtesy of the Engineering Record.

stream. The water for the power is taken from the reservoir above the dam through a set of heavy masonry feeders, which empty into the canal.

The power house is built upon the outer bank of the canal, coffer dams on both canal and river side having first been built to protect it during construction from freshets in the river. The first stone was laid in July, 1896, and work proceeded without interruption until finally completed in the spring of 1897. The power house of brick is 184 feet long, 30 feet wide and 32 feet high from floor to truss. A projection on the river side, 7 feet by 48 feet, allows ample space for the switchboards and a stairway. A monitor roof runs the entire length of the building, and in the centre of the river side wall is a tower from which the outgoing wires pass to the poles. A 20-ton traveling crane runs the length of the building on a steel beam track, supported by an offset from the brick wall.



Power House from Head Race Side.

The floor is of cement concrete 3½ feet thick, and forms the arches of the tail race. The walls of these and the foundations are of solid granite rubble and cement.

The water wheels, as in the Folsom-Sacramento generating station, are outside of the power house in steel flumes or tubes running underground from the forebay to the wall of the power house, a distance of about 30 feet. Each turbine consists of two 51-inch McCormick water wheels, furnished by the Rodney Hunt Machine Company, of Orange, Mass., and flumes and wheel pits have been provided for eight pairs of wheels. Three only are now in position. They are designed for a 29-foot head, and each pair develops 1250 horse-power at a speed of 150 r. p. m.

The wheels are mounted on horizontal shafts in flumes 33 feet 4 inches long and 14 feet in diameter. The central discharge system of mounting the wheels is employed, using one draft tube about midway in the flume. Water is admitted from the forebay into the flumes by hand gates, and the operation of each turbine is controlled by a Lombard water wheel governor. A steel rack in front of the gates effectually prevents the ingress of foreign matter to the wheels.

The electrical system of generation is the three-phase alternating, and the entire electrical equipment was manufacturd by the General Electric Company. The generators are thirty-two pole, three-phase, alternating current evolving armature machines of a rated capacity of 750 kilowatts, delivering 40-cycle current at 3450 volts. They are directly coupled to the turbine shafts.

Power House from Tail Race Side.

The vertical diameter of the generator field ring is 13 feet 10 inches. It weighs 45,000 pounds, and rests on a bed plate weighing 23,000 pounds. The pole pieces are built up of steel laminations cast into the field ring, the coils are wound on forms previous to application, and may be easily renewed and replaced without disturbing the rest of the structure. The field ring is susceptible of movement along the base, uncovering the armature for inspection or repair. The armature measures 9 feet in diameter and weighs 31,000 pounds. The brushes are supported by two stands bolted to the bed plate. The generator base frames are secured to the foundations by four bolts, 6 feet long 2½ inches in diameter, to two channel irons embedded in the concrete. The bed on which the generator rests is also of concrete, and is 1 foot higher than the floor of the power house.

An exciter is provided for each generator, and is driven from a pulley on the shaft. It is a four-pole dynamo of 30-kw capacity, furnishing direct current at 125 volts at a speed of 440 revolutions.

The conductors from the generators pass under the wooden floor to the switchboard, which is made up at present of four panels, one

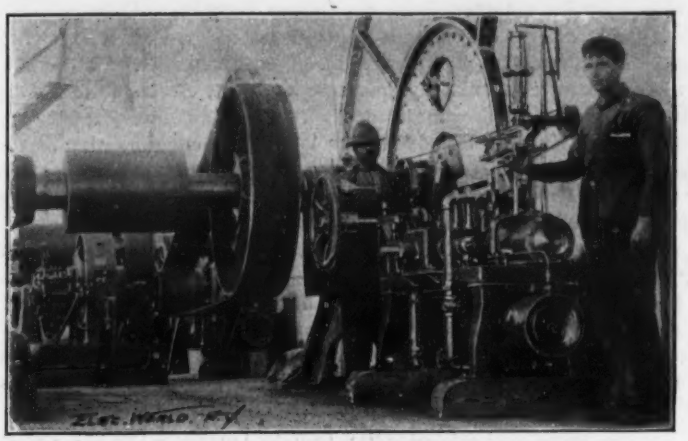
for each generator, 36 inches wide and 7 feet 6 inches high, and one for the exciter 30 inches wide, and of the same height. All are of polished blue Vermont marble, 2 inches thick.

Each generator panel carries three ammeters, one on the main line, another for the generator field, and the third for the exciter; one triple-pole single-throw switch, one double-pole generator field switch and one double-pole exciter switch, one generator field rheostat, one exciter field rheostat, two pilot lamps, as well as three fuse blocks for the generator and two for the exciter.

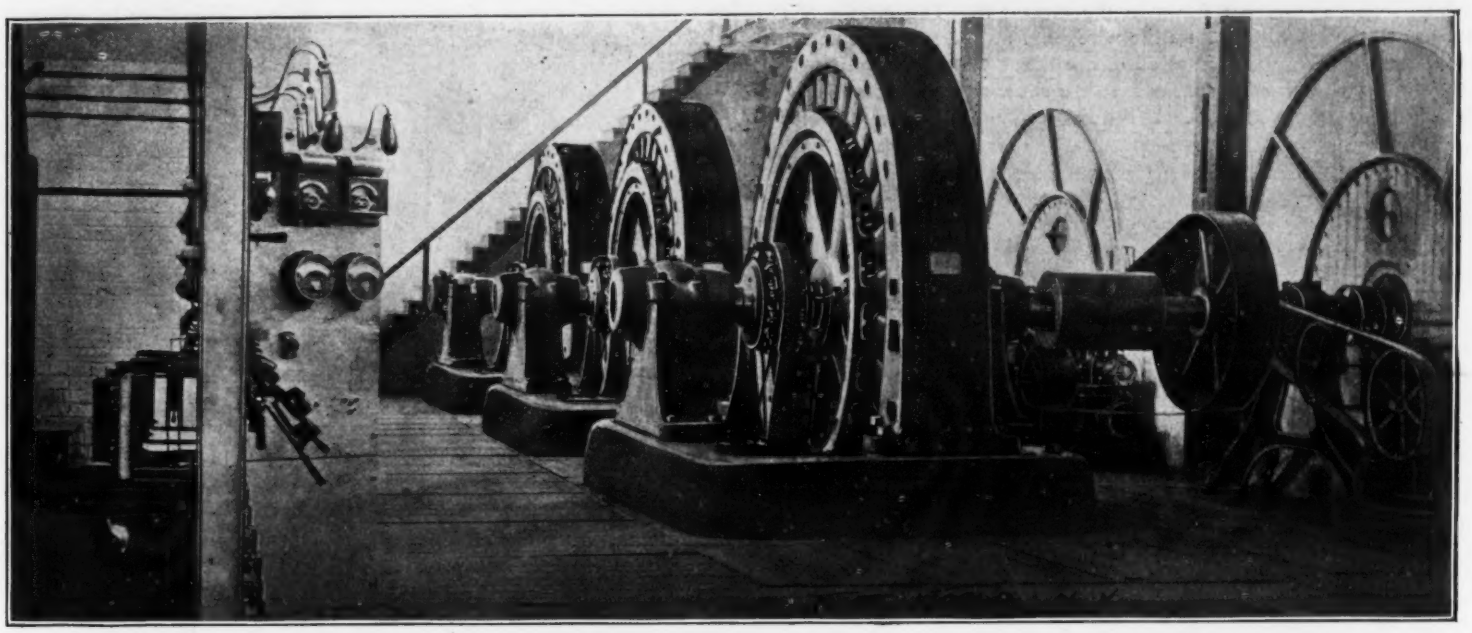
The exciter panel carries two 150-volt voltmeters for the exciters, two 125-volt voltmeters for the alternating-current circuits, one potential switch for the exciters and one for the generators, two ground detector plugs and two potential transformers. This exciter panel is attached by hinges to the generator panels at the end of the board and may be swung to any position in line with or at right angles to the board. The latter position is of great convenience when synchronizing the generators.

From the switchboard the transmission lines run to the wire tower and pass to the poles. The principal customer of the Columbia Water Power Company is the Granby Mills, manufacturing print cloths, about 1½ miles distant from the power house. The transmission lines, on reaching the mills, are brought into a special transformer room where, in four step-down transformers of the air-blast type, each of 265-kw capacity, the line voltage is reduced to 550 volts for the motors. In this room are also installed three transformers, each of 30-kw capacity, in which the pressure is reduced to 110 volts for the lighting of the mill, which is effected by about 1200 lights.

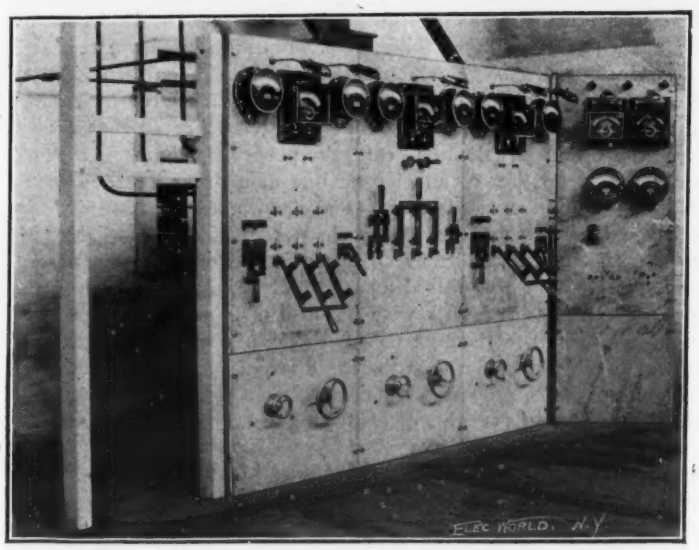
The motors installed are four of 150 horse-power and one of 75 horse-power. All are 550-volt induction motors, and are suspended in an inverted position from the ceiling beams. The motor is coupled to the line shaft, from which some machines are directly belted, while others are driven through countershafting, itself driven from the main shaft.



EXCITER AND GOVERNOR.



VIEW OF MAIN GENERATORS



THE SWITCHBOARD, SHOWING CONCEALMENT OF SWITCH CLIPS.

The induction motors have about 50 per cent. greater starting torque than the full load running torque. They have a special resistance in the rotating secondary, which is short circuited when the motor is running. The slots are open, and the coils are machine wound and insulated before application to the cores. There are no sliding contacts in either circuit. All the motors in the Granby Mills run at the speed of 600 r. p. m. They require little or no attention beyond an occasional oiling, as they are so much simpler than direct-current motors.

Other mills are now contemplated which will take power from the new power house. The current will be sold by meter, the meters being placed in the secondary circuits. The advantages of the meter arrangement can be readily understood. If any mill is shut down for any reason, the power expense stops immediately, and begins only when the mill starts again. Furthermore, a mill can operate any portion of its machinery without the expense entailed in the running of a lot of idle shafting, payment being exacted only for the power consumed.

The Columbia Water Power Company is composed largely of New England capitalists. The late Aretas Blood, of Manchester, N. H., was at the head of the enterprise and associated with him were A. F. Sortwell and George Wallace, of Boston, Mass. The general contractors were W. A. Chapman & Co., of Providence, R. I.; the engineer, A. G. Stevens, of Manchester, N. H. and the electrical contractors the General Electric Company. W. W. Hawkins is managing engineer, and Mr. F. P. Carpenter is president.

Oscillatory Currents and Some of Their Phenomena—V.

BY PROF. E. F. NORTHRUP.

It will be of interest to consider the powerful inductive effects which may be obtained from oscillatory currents. With the ordinary alternating currents in commercial use we only have one kind of induction to consider, namely, electromagnetic induction. In high potential oscillatory currents, however, electrostatic induction becomes of equal importance with electromagnetic induction, and its powerful effects may not be left out of consideration. According to the arrangements of our circuits we may make prominent either electromagnetic or electrostatic induction or the effects of both may be made of about equal importance.

First consider Fig. 22, in which are shown two circuits arranged so that the electromagnetic induction is chiefly prominent. C_1 is a pair of metal plates parallel to one another and separated a short distance, say 1 inch. These plates form a condenser of small capacity. P is an open circle of heavy wire joined to these plates, as shown in the figure, and having a discharge gap at G. The wires W go to the high potential transformer. To produce strong oscillations and to prevent an excessive flow of current from the transformer the condenser C, of greater capacity than C_1, is in circuit with one of these wires. When the transformer is working a powerful oscillatory current flows in the circuit P. The circuit S is similar to the circuit P. At s the wires end in fine points separated from each other a small fraction of an inch. When the oscillatory currents flow in P small sparks across s show that currents of high E. M. F. are induced in S. If the two circuits P and S are electrically tuned, that is if the oscillatory currents in the two circuits would have the same natural frequency, the currents induced in S will be much greater than if the two circuits are out of tune. When the currents flow in P, magnetic lines of induction thread through P, and a few of these lines reach out so as to thread through S also. As is well known the E. M. F. set up in S is proportional to the number of these lines of magnetic induction which thread through its circuit per second; hence, though the currents in P may be small, the lines of force which these currents set up pass into and out of the circuit S with enormous rapidity, making the *rate* of change of the induction through S great enough so that sparks will pass across the gap s. This kind of induction is called electromagnetic, and is practically the only kind operating on the circuit S.

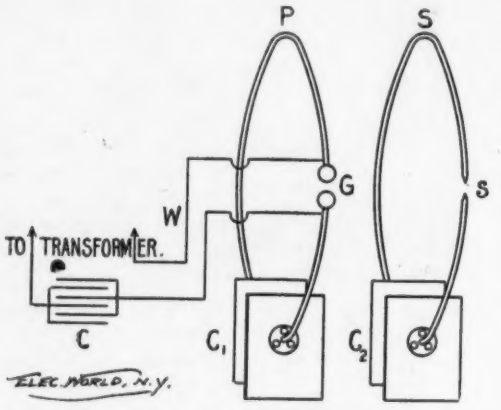
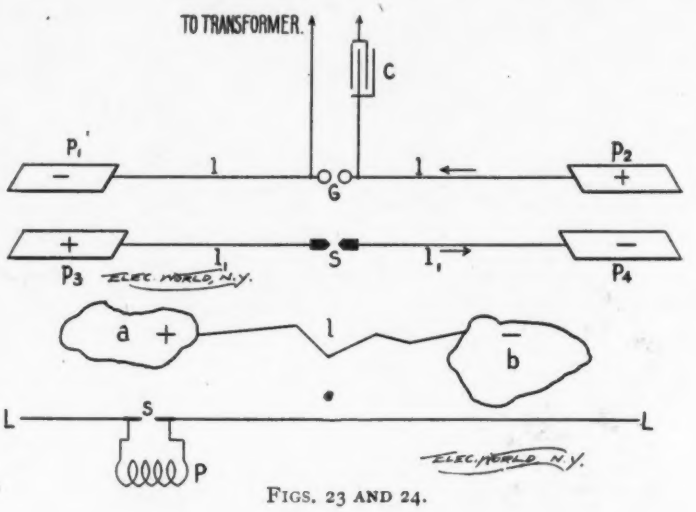


FIG. 22.

Consider next the arrangement illustrated in Fig. 23. Here p_1 p_2 p_3 p_4 are four metal plates. The two pairs each have their plates with faces parallel and facing each other. C is a condenser having the same purpose as the condenser C in Fig. 22. When the transformer is in action an oscillatory current will flow in the straight wire $l\,l$. The plates p_1 p_2, though far apart, have capacity enough to form a condenser. Neglecting for the moment the electromagnetic action of the currents, we will see that there is a strong electrostatic inductive action at work tending to set up currents in the wire $l_1\,l_1$. As the current oscillates back and forth in the wire $l\,l$, p_1 and p_2 are charged positively and negatively in rapid succession. When p_1 is negative p_3 becomes positive by electrostatic induction, while in the same way p_4 becomes negative through the action of the positive charge on p_2.

When the charges on the plates p_1 p_2 are reversed the inductive action reverses the charges on the plates p_3 p_4. Now for p_3 and p_4 to become charged there must be a flow of electricity from one plate to the other, which means that a current flows in the wire $l_1\,l_1$. Since the charges on p_3 and p_4 are reversed as often as the charges on p_1 and p_2 the current which flows in $l_1\,l_1$ must oscillate back and forth at the same rate that the current in $l\,l$ does. In addition to this induction, which is called electrostatic, producing a current in the secondary circuit, there is the electromagnetic induction of the wire $l\,l$ on the wire $l_1\,l_1$. A little consideration will show that these two kinds of induction act so as to assist rather than to oppose one another. Suppose the positive charge on p_2 has reached a maximum value and has begun to grow less; this means that the current in the direction of the arrow is beginning to flow in $l\,l$. This current in $l\,l$, by electromagnetic action, would induce a current in $l_1\,l_1$ in the opposite direction, as indicated by the arrow. A diminishing positive charge on p_2, however, means a diminishing negative, that is an increasing positive charge on p_4, which means a current flowing from p_3 to p_4. Thus it is evident that both the inductive actions operate together to send the current in $l_1\,l_1$ in the same direction. These induced currents will be made evident by a small spark at the gap between points at S. By making the wires $l\,l$ and $l_1\,l_1$ very short, or by separating them a long distance from each other, the inductive action may become almost wholly electrostatic.

To make a spark jump across a gap requires an E. M. F. of at least 300 volts, however short the gap may be. Therefore in order to obtain sparks the inductive action must be very powerful. To make the inductive action powerful we may bring the two circuits very close together or we may pass very strong currents through the primary circuit by making the gap G very great, and then use a transformer of sufficiently high E. M. F. to cause a discharge to take place over this gap. This latter condition we have realized in a lightning discharge which takes place between two clouds. Suppose a and b, Fig. 24, are two clouds that are oppositely charged, and that they have approached each other so that a discharge represented by the line l can take place between them. Suppose $L\,L$ is a portion of an electric line at a great distance from the discharge but approximately parallel with its direction. The discharge between the two clouds is an oscillatory discharge of very great frequency, and may consist of currents of great volume. The inductive action of this discharge will be very strong, and its effect may be observed on a wire $L\,L$ at a distance of perhaps several miles. Suppose the line passes through a motor at P which has a large self induction, then the rapidly oscillatory current which is set up in the line by the inductive action of the lightning discharge will find great difficulty in passing through this portion of the line, and will prefer to jump across an air gap, as s. Thus the small air gap, s, has taken the lightning discharge and protected the motor P. Air gaps such as s are placed on all lines now, and are known as lightning arresters. Their action is thus seen to be made possible as a consequence of the extraordinary rate at which oscillatory currents change their direction and magnitude.



FIGS. 23 AND 24.

This aspect of the subject of oscillatory currents has been developed and explained with the aid of many beautiful experiments by Oliver Lodge, and everyone interested in the magnificent oscillatory currents which nature produces in lightning discharges should read his book on "Lightning and Lightning Conductors."

Since nature produces such powerful inductive effects that a

switchboard may become a display of electric fireworks when a storm is several miles distant, the question arises if such inductive action may not be produced and controlled in a way to be used for purposes of signalling without wires. While most commendable success has been already obtained by Marconi in signalling long distances with the aid of electric waves produced by oscillatory currents of very great frequency, the author believes that, if only for the sake of comparison, other methods in which more slowly oscillatory currents are employed should be tried and thoroughly tested.

The author made some small experiments on distant induction with oscillatory currents which would have encouraged him to go on if time and the funds had been at his disposal. These will be found described in THE ELECTRICAL WORLD for December 18 and 25, 1897. Interesting results will at least be obtained by anyone who will try experiments along this line somewhat as follows:

Arrange matters as shown in Fig. 25. C_1 and C_2 are two air condensers, each made of two square sheets of tin or copper. Let each of these sheets be about 6 inches. Connect the lower sheet of each to the earth by a wide strip of metal, and see that a good ground connection is made. The two upper sheets are connected by a heavy copper wire making three sides of a rectangle, as shown in the figure. This rectangle may be about 30 metres long, and its

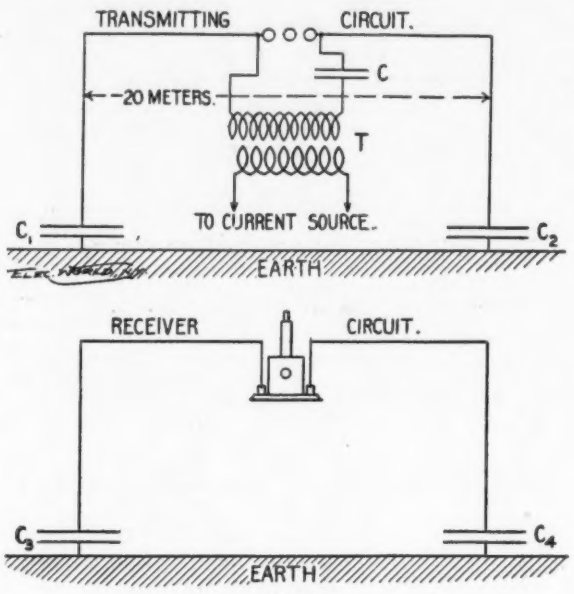


FIG 25.

plane must be perpendicular to the plane of the horizon. Insert a double discharge gap and connect, as shown, across this spark gap the secondary of a transformer with a small but very strong condenser, *c*, in series. The distances to which the induction effects may be sent will depend very greatly upon the E. M. F. which this transformer can furnish. I believe it would be feasible to construct one which would give a 6-inch discharge through air. With such a transformer the induction effects could be observed at distances measured by several miles. Construct a receiving circuit exactly like the transmitting circuit described above, but in place of the discharge gap insert in the side of the rectangle an oscillating current galvanometer. This instrument and its capabilities have been described in THE ELECTRICAL WORLD, December 18 and 25, 1897.

The instrument serves for alternating currents practically the same purpose that a very delicate galvanometer does for direct currents. It is specially sensitive when applied to detecting and comparing the values of different oscillating currents, for the more rapidly the currents oscillate the more sensitive the instrument is.

For a first trial the secondary circuit might be placed one mile from the transmitting circuit, and if the transformer gives as much as a 3-inch discharge and the instrument is constructed as described in the article referred to it would surely give readable deflections whenever the current is sent through the transmitting circuit. The extreme distances to which it is possible to transmit signals in this way can only be determined by actual trial, but there are reasons to suppose that they may be made as great or greater than the distances over which Marconi has signalled by means of short electric waves. The condensers have been arranged in the manner indicated with the idea that the oscillatory currents through the earth might, by spreading out laterally, help to increase the inductive effect. To perform this experiment successfully it will be necessary to arrange the two circuits so that they will be electrically tuned or in synchronism. This can easily be arranged by making the secondary circuit very nearly the same as the transmitting circuit to start with. Then change the distances between the plates of the two condensers in the receiving circuit until, by trial, the instrument gives the largest deflections which it is capable of giving at any particular distance between the circuits. The induction effects to be obtained in this way will not be hindered by houses or any semi-conducting obstacle. It would be interesting to determine to what extent the induction would be hindered by a hill between the two circuits.

The subject of electric waves or electric radiation has scarcely been referred to. The reason for this is that to give a clear explanation of just what electric radiation is and the many phenomena connected with it would lead us into descriptions much longer than what has already been written. Suffice it to say that when the frequency of an oscillatory current becomes very great much of the energy of the current passes off into space in the form of a radiation in every respect like ordinary light and radiant heat, except that the length of the waves is much greater than that of light or heat waves. Formerly when the spectrum was spoken of, one thought only of what appears on the screen when light passes through a prism. Now, however, we must extend our conceptions of a spectrum. Beginning with waves thousands of miles long given forth by a slowly oscillating current, we pass by gradual gradations to waves a few centimetres long given out by electricity oscillating on a small sphere. We next observe long heat waves radiated from a hot body; we then pass on through shorter heat waves to waves of red light, then without further discontinuity through the waves of violet light to the short actinic waves which act most strongly on the photographic plate. Then comes a gap, not probably in nature, but in our observations, and we have next the X-rays, which many think consist merely of still shorter waves than the waves which constitute actinic rays. All these varieties of radiation, with the possible exception of the X-rays, travel with exactly the same velocity, about 186,000 miles a second. If anyone could prove that the X-rays traveled with this velocity the presumption would be overwhelming that these rays are in all respects a species of electric or light radiation. Electricity oscillating on a sphere gives rise to waves which are measured by inches, possibly electricity oscillating on the atoms of matter gives rise to waves measured by millionths of an inch, and these may constitute the Röntgen rays. At all events the mysteries of these oscillatory currents are far from being all solved, and no line of experimental work in electricity will yield more fruitful results than this.

CONCLUDED.

The Protection of Steam-Heated Surfaces.*

BY C. L. NORTON.

The investigation of which this is a partial report has been undertaken at the request of Mr. Edward Atkinson, and has been pursued during a large part of the years 1896 and 1897, and is yet uncompleted.The first object sought for was the relative efficiency of several kinds of steam pipe covering now upon the market. The second object was to ascertain the fire risk attendant upon the use of certain methods and materials used for insulation of steam pipes. Third, an attempt was made to show the gain in economy attendant upon the increase of thickness of coverings, and to show also the exact financial return which may be expected from a given outlay for covering steam pipes.

The method adopted is one which, so far as I know, is original. A piece of steam pipe is heated from the inside electrically. The amount of electrical energy supplied is measured, and hence the amount of heat furnished is known. If the steam pipe is kept at a constant temperature by a given amount of heat it is because that amount is just equal to the heat it is losing, for if the supply were not equal to the loss the temperature would rise or fall. In other words, the heat put into the pipe is just equal to the heat lost from it by radiation, convection and conduction. By measuring the electrical energy supplied I can determine the heat put in, and hence

*A paper presented at the Niagara Falls meeting (June, 1898), of the American Society of Mechanical Engineers, slightly abstracted.

the heat given out or lost. It must be borne in mind that a given amount of electrical energy always produces the same definite amount of heat, the amount of heat furnished by one electrical unit of energy being known with greater accuracy than the amount of heat given out by a pound of steam in condensing.

The apparatus for making tests by this method comprises several pieces of steam pipe of different diameters and lengths, heated electrically from within by means of coils of wire in oil. The oil is stirred vigorously and serves as a very efficient carrier of heat from the wires to the pipes. A brief description of the smallest tester may make the details of the apparatus more easily understood.

A piece of 4-inch steam pipe, 18 inches long, is closed at one end by a plate welded in, and at the other by a tightly fitting cover. This pipe is filled with cylinder oil, and a coil of wire, a thermometer and a stirrer are introduced into the oil. An ammeter and voltmeter, or a wattmeter, may then be connected so as to record the amount of electrical energy supplied. The stirring must be brisk, and if enough power is put into the stirrer to be comparable with the electrical energy supplied, such amount must of course be added, as it also is converted into heat. It is my custom to suspend the apparatus in the middle of the room on non-conducting cords and read the thermometer with a telescope, so that no heat from the person of the observer may be added to the supply given to the cover from within, and also that care may be taken not to produce air currents by walking near the apparatus during a test.

In making a test the following operations are carried out, and observations are taken in the following order:

The current is turned on, and heat is generated in the wire coil until the wire, oil and steam pipe have reached the desired temperature at which it is proposed to test. The current is then gradually diminished until it is found to be of just the amount necessary to keep the pipe at this temperature without a rise or fall of one-tenth of a degree in thirty minutes. A reading of the voltage and current is now taken at intervals of thirty seconds, and the watts and B. T. U. are computed from their average. We then have the number of B. T. U. per minute lost from the outside of this particular pipe at this particular temperature. If now we place a steam pipe cover around the pipe we shall find that a less amount of energy is sufficient to keep it at the required temperature, the difference being the amount of heat saved by the covering. The minimum length of time considered sufficient for the equalization of heat, or "soaking in" to the cover, is six hours. If, after a second heating of six hours, no change in the conducting power is noted, the cover is considered in a permanent condition and is tested. Some covers, notably those composed wholly or in part of wool, cannot be considered dry and constant until after an exposure upon a pipe at 200 pounds' pressure for six or eight days. Covers containing sulphate of lime are also slow in drying.

Table I. gives the relative conductivity of most of the various kinds of steam pipe cover tested up to April, 1898, some being omitted when found to be of such low efficiency as to be of doubtful value.

TABLE I.

Specimen.	Name.	B. T. U. Loss per Sq. Ft. Pipe Surface per Min.	Ratio in per cent. of Loss to Loss, from Bare Pipe.	Thickness in Inches.	Weight in Ounce per Ft. of Length 4 In. Diam.
A	Nonpareil cork standard	2.20	15.9	1.00	27
B	Nonpareil cork octagonal	2.38	17.2	.80	16
C	Manville high pressure	2.38	17.2	1.25	54
D	Magnesia	2.45	17.7	1.12	35
E	Imperial asbestos	2.49	18.0	1.12	45
F	W. B.	2.62	18.9	1.12	59
G	Asbestos air cell	2.77	20.0	1 12	35
H	Manville infusorial earth	2.80	20.2	1.50	....
I	Manville low pressure	2.87	20 7	1.25	....
J	Manville magnesia asbestos	2.88	20.8	1.50	65
K	Magnabestos	2.91	21.0	1 12	48
L	Moulded sectional	3.00	21.7	1.12	41
M	Marsden infusorial earth	3 11	22.5	1.00	50
N	Marsden infusorial earth	3.27	23 7	1.00	43
O	Asbestos fire board	3.33	24.1	1.12	35
P	Calcite	3.61	26.1	1. 2	66
	Bare pipe	13.84	100	....	....

Specimen A consists of granulated cork pressed in a mould at high temperature, and then submitted to a fireproofing process.

Specimen B is similar in composition, but is made up of several strips of cork instead of two semi-cylindrical sections.

Specimen C is a section cover composed of an inner jacket of earthy material and an outer jacket of wool felt, the whole being one and one-quarter inches thick.

Specimen D is a moulded sectional cover composed of about 90 per cent. carbonate of magnesia.

Specimen E is essentially an air cell cover, being composed of sheets of asbestos paper which have been indented before being laid up, the indentations serving to keep the thin sheets of paper from coming in contact with one another, thereby causing a considerable amount of air to be held throughout the body of the cover.

Specimen F is composed of a wool felt with a lining of asbestos paper.

Specimen G is a cover made up of thin sheets of asbestos paper fluted or corrugated and stuck together with silicate of soda.

Specimen H is a plastic covering made of infusorial earth.

Specimen I is a low pressure covering similar to specimen F.

Specimen J is a plastic cover, and called by the makers magnesia-asbestos. It contains only a slight amount of carbonate of magnesia.

Specimen K.—The magnabestos is a moulded cover, containing about 45 per cent. of carbonate of magnesia and a considerable percentage of carbonate of lime.

Specimen L is composed mainly of sulphate of lime and some 20 per cent. of carbonate of magnesia and has upon its outer surface a thick sheet of felt board.

Specimen M is a sectional moulded cover. It is composed largely of infusorial earth from California.

Specimen N is similar to specimen M, except that to its composition has been added some 45 per cent. of carbonate of magnesia.

Specimen O is similar to specimen G, except that it has larger cells and contains much more silicate of soda. It is very hard and strong.

Specimen P is a sectional moulded cover, composed mainly of sulphate of calcium. It has an outer layer of felt board.

In regard to the compositions of specimens C, J, L and P, I desire to state that I have made no complete analysis, but have satisfied myself that the principal ingredient is sulphate of calcium and not carbonate of magnesia. Prospective purchasers of pipe covers should not be misled by names. Since the appearance of Professor Ordway's reports it has been recognized that carbonate of magnesia was of great value as a non-conductor of heat, hence the name "Magnesia" has been applied to a great many covers. It is to be observed that there is no virtue in a name. Asbestos is merely an incombustible material in which air may be entrapped, but when not porous is a good conductor of heat. Magnesia is a most effective non-conductor. This name has been applied to many compounds of which the greater part consist of carbonate of lime or plaster of paris, materials which are not good as a heat retardent. The percentage of magnesia carbonate and plaster of paris in several moulded sectional covers is given in Table II.

TABLE II.

Specimen.	Percentage Composition.	
	$MgCO_3$.	$CaSO_4$.
D	80 to 90	3
C	less than 5	65 to 75
L	20 to 25	50 to 60
P	less than 5	75
J	10 to 15	none.

TABLE III.

Specimen.	Name.	Loss B. T. U. 200 lbs.	Saving B. T. U.	Saving per year per 100 sq. ft.
A	Nonpareil cork standard	2.20	11.64	$37.80
B	Nonpareil cork octagonal	2.38	11.46	37.20
C	Manville sectional, H. P.	2.38	11.46	37.20
D	Magnesia	2.45	11.39	36.90
E	Imperial asbestos	2.49	11.35	36.80
F	"W. B."	2.62	11.22	36 40
G	Asbestos air cell	2.77	11.07	36.00
H	Manville infusorial earth	2.80	11.04	35.85
I	Manville low pressure	2 87	10.97	35.65
J	Manville magnesia asbestos	2.88	10.96	35.60
K	Magnabestos	2.91	10.93	35.50
L	Moulded sectional	3.00	10.84	35.20
M	Marsden No. 2	3.11	10.73	34.85
N	Marsden No. 1	3.27	10.57	34.60
O	Asbestos fire board.	3.33	10.51	34.20
P	Calcite	3.61	10.23	33.24
	Bare pipe	13.84	0.00	

Table III. gives the saving, in dollars, due to the use of the various covers. The money saving is computed on the following assumptions. Coal at $4 a ton evaporates 10 pounds of water per pound of coal. The pipes are kept hot ten hours a day 310 days a year. If computations are made, as is sometimes done, on an assumption that the pipes are hot twenty-four hours a day 365 days in a year, the saving is nearly three times that shown in Table III.

Generally speaking a cover saves heat enough to pay for itself in a little less than a year, at 310 ten-hour days, and in about four months at 365 twenty-four-hour days.

It is evident that the decision as to the choice of cover must come from other considerations as well as from the conductivity.

The question of the ability of a pipe cover to withstand the action of heat for a prolonged period without being destroyed or rendered less efficient is of vital importance. The increasing use of cork as an insulator has led to many questions as to its ability to remain "fireproof." I have exposed it to a temperature corresponding to 350 pounds of steam for three months, and to a temperature corresponding to 100 pounds for two years, and can detect no change, and I am satisfied, as well as one can be without the actual experience, that any suspicion of its ability to withstand continual heating is groundless.

The magnesia covering is, of course, unquestionable on this ground, being almost indestructible by heating.

The Imperial asbestos is also perfectly safe from any fire risks, as is the air cell and fire board.

The Manville and Marsden infusorial earth and also the Manville asbestos-magnesia are liable to no accident from fire, nor is the Carey calcite.

It is to those covers, the "W. B.," of the Watson Company, and the Manville sectional and others which possess a composite structure that I desire to call attention. I do not consider it safe to put upon a steam pipe wool, hair, felt, or woolen felt in any form. The causes of risks are two: First, the wool may become charred by heat from the pipe and finally ignited. However, this can hardly happen, even on high pressure pipes, when the thickness of fireproof material, asbestos, magnesia, or whatever it may be, is of as great a thickness as one inch.

The second and most serious risk in their use is from the presence in shops or mills of the long tubes of wool, dry as tinder, often connecting one room with another, and ready to flash at the slightest rise in the already too great temperature. I would even insist that the canvas jackets of the covers be fireproof. An accident in my own laboratory has proved the actual danger of these wool felts, and I should not be willing to allow their use again. Their efficiency is high as non-conductors, but not higher than any other perfectly safe covers. If the wool is separated by about one inch of fireproof material from the pipe it is not kept so hot and dry, and the risk from outside ignition is less, but I do not indorse the practice of many engineers in wrapping hair felt outside of a sectional cover.

In general it may be said, therefore, that if five years is the length of life of a cover, one inch is the most economical thickness, while a cover which has a life of ten years may to advantage be made two inches thick.

A very thorough test was made of the common method of judging a pipe cover by the sensation of warmth given the hand on touching it, and nothing too harsh can be said of this practice. The sensation is dependent to such an extent upon the nature of the surface that it fails utterly to give any idea of the actual temperature. I have been unable to devise any method of so attaching a mercury thermometer to the outside of a steam pipe cover as to make use of it as a testing device in measuring heat loss.

I am desirous of calling attention to the advantages arising from the use of plastic rather than sectional covers. The ease of removal for repairs or alterations makes the sectional cover better for some work, but there is much pipe surface which might be covered securely with plastic where a sectional cover is soon ruined by vibration.

Of course the plastic covers offer no possibility of leaky joints and long cracks. It should be borne in mind that in most cases about 20 per cent. of the entire surface to be covered is irregular, and must be covered by plastic or fittings. It will be well for prospective purchasers of pipe cover to see to it that their contracts call for fittings and plastic of as high an efficiency as the sectional cover shows.

Lightning and Lightning Arresters—I.

BY H. E RAYMOND.

The season has arrived when the electrical fraternity finds common interest in the displays of nature. Among the harbingers of spring, electrical storms and other minor disturbances stand prominently in our view. The damage done by lightning is a very serious hindrance, in many cases, to the establishment of a dividend paying basis. It is estimated that between $300,000 and $400,000 loss is annually incurred from this source, and it stands to reason that any reliable protection would be of inestimable value. The damage is widespread in its effects, and includes almost everything —from simply blowing a transformer fuse, to directly demolishing stacks and buildings.

It is the purpose of this paper to give as clearly and simply as possible the results of several years' observations and experiments in the line of protection against damage from atmospheric disturbances; and I trust that it may, in part at least, prove of value to such station managers, or power plant superintendents, as have had no time nor opportunity to study these ever recurring phenomena.

In considering lightning protection, it becomes necessary to view the matter from every possible direction. There are, however, to all intents and purposes but two main divisions necessary for discussion. First, direct stroke by a "bolt," and second, the charging of a wire by induction. They both admit, and in fact require, sub-division into many heads, the latter in particular.

To absolutely protect machinery from the action of a direct stroke, which comes fairly upon the wires themselves, is a problem that is, to say the least, very difficult to solve. Probably it would be much more to our advantage to devise means for diverting it from the service wires. Lightning is such a terrific power and is capable of such enormous leaps that it does not seem possible to divert it from vulnerable portions of a system which it happens to hit by means of a few insignificant little cylinders of metal separated by small spaces. It would appear as though, once fairly upon a wire, it would develop such a local heat and electrostatic strain that any arrester would melt, and that any paths it might take to the ground would suffer great damage.

At the present day the most satisfactory and effective method of protecting is that one in which a grounded wire is strung in proximity with the line wires. This should be preferably barbed wire. and frequently grounded. It should be in such a position relative to the other wires as to more favorably receive any discharge from a cloud. This location is probably above and outside the main wires, situated at a convenient distance, or about 12 to 18 inches. It would afford additional safety if a third wire were strung from pole to pole directly over their centres. A still further precaution would often warrant the expense incurred in protecting the poles themselves. This protection is afforded by simply running a wire down the side of every five or ten poles, grounding thoroughly one end, and allowing the other to project above the peak of the poles about a foot.

It is generally understood that any aerial line is influenced by the charge resident in a passing cloud. The cloud, of course, induces in the earth a charge of opposite potential. The line being between the two is affected by the charge to an extent depending upon the distance it is above ground, and upon the intensity of the charge. Should this wire be buried in the earth, or simply lie along its surface, making contact here and there, no charge would be received by the wire other than that in the earth and there could be no difference in potential between them. This would, of course, be impractical in running service lines, and the next best effective way is to lift the ground level to that of the wires, which is practically accomplished by the above means.

As a path for a direct stroke of lightning, a plain wire would probably serve as well as the barbed wire, but as most of the line disturbances seem due to a more or less gradual charging of the system, it is economy to use one stone for the two birds. We are all familiar with the fact that static electricity will escape more readily from points than from a smooth surface; and the numerous points on a barbed wire connected to the earth will rapidly discharge a portion of the earth's charge, and neutralize that of the line, reducing their potential difference to zero, or near enough for all purposes. This phenomenon of gradual charge would appear to be the most easily disposed of, but it has until lately been a source of continual expense, worry and interruption to service. It has been necessary to provide a path to earth, which would offer free passage

to this induced potential, but which would oppose the transition of dynamo current. Numberless devices have been evolved, manufactured and floated on the market. They have all been tried, and while some were successful to a certain degree there were many total failures.

In the early stages of commercial electricity the machinery was confined to direct-current arc and incandescent, with a voltage necessarily low. The arc systems carried the highest pressure, and were more liable to grounds, therefore being more subject to disturbance from atmospheric discharges. Probably the most effective early arrester for use on such circuits was the Thomson type with electrodes, shaped like a butterfly's wing, situated in a magnetic field. The field forced the arc upward, and in so doing the diverging terminals caused the arc to lengthen to such a degree that the generator voltage was incapable of maintaining it. The low-tension incandescent type was about the same, allowance being made for the lower voltage and the heavier currents employed.

As electricity became more and more a factor in the progress of civilization and industries the limitations of the original machines became more apparent, and newer types were designed to more nearly meet all the exacting conditions. As it became, unavoidably, of higher pressure the question of rupturing or preventing the arc became more difficult of solution until it seemed as if it would be necessary to so enlarge the gap in order to insure self-protection that the discharging value of the arrester would be practically annihilated.

The early types of arresters all contained some form of arc-rupturing device, either magnetic, mechanical or fusible; and these required that the electrodes be a certain distance apart, in order that the arc could be drawn out to such a length that it might be broken. In many styles this air space was so great that there was necessitated a jumping potential sometimes twice that for which the dynamos were insulated. This, it is evident, diminished the effectiveness of the arrester to a mere chance.

As the art in manufacturing advanced, methods of insulating improved to such a degree that, at the present day, machine insulation capable of withstanding a pressure of from 5000 to 10,000 volts is common practice. It does not follow, however, that this marked improvement in the custom of insulating is warrant for the employment of lightning arresters requiring for action any very great increase of potential. Boilers tested at 400 pounds per square inch hydraulic pressure are not intended to operate at anything approaching that amount, and safety valves are always set so as to open at but slight increase over ordinary working pressure. It would be deemed a piece of worse than folly for any engineer to set at 200 to 300 pounds per square inch the safety valves which protect a boiler operating at 125 pounds, and yet it is no uncommon thing to see systems supplying current at 560 volts "protected" by arresters requiring for action a discharging potential equal to from 3000 to 8000 volts. The arc following a discharge on a direct-current system is particularly persistent, and if a storm is of long duration the electrodes are apt to become so heated that when the arc is ruptured the molten metal will be blown out also, and the gap increased at the time it is most needed in its normal minimum length. Sometimes the vapor from the heated metal will form a path of such low resistance that the dynamo voltage will start an arc across the points and a short circuit ensue.

There are two ways to prevent this: One to use for electrodes non-arcing metal; the other to use metal of considerable mass and cut down the possible current on discharge by the insertion of a comparatively low resistance. Possibly a better way than either would be to combine the active principle of both, and use with the non-arcing metal a small resistance. It has been found necessary to employ a certain number of gaps, of certain distance apart, for certain voltages, and at certain points this gap space becomes prohibitively great. If a small resistance is inserted in the circuit the gap space may be materially lessened, and the striking voltage consequently lowered.

It has been found by Mr. A. J. Wurts that certain metals are possessed of properties making them incapable of maintaining an arc. Presumably they are alloys of copper and metals of the zinc group, generally zinc itself. Many forms of commercial brass, rolled or drawn, possess this property and exhibit a striking effect under absolute short circuit at very high voltages, as nothing but the tiniest spark is visible. It seems to be established, and is generally conceded, that this is due to the fact that a non-conducting vapor is formed by the oxidation of the metal at the discharge, and this vapor sets an insulating barrier between the electrodes. This theory is greatly strengthened by the fact that if the cylinders are separated any distance the arc will not be extinguished, it apparently being necessary to confine the concentrated vapor to a small space.

Arresters of this material alone will generally prove reliable, so far as preventing the dynamo current from following the discharge is concerned. I have been able to learn of but four cases where the arrester was damaged by the line current. The greatest drawback to the simple non-arcing type of arrester is the necessity for a very considerable air space, or number of gaps, if it is to be in use on lines carrying high potential.

The other main type of arrester, that employing metal without regard to non-arcing features, employs a magnetic field for blowing out the arc. The magnetic blow out is a most effective method of rupturing an arc, but alone it bears this objection: When an arc is started across two terminals they, of course, come to an intense heat, which softens the metal, this hot metal is sufficiently plastic to be blown out when the arc is, and it is nothing unusual to see large drops of metal violently ejected during a discharge, thus increasing the gap. This trouble has been partially overcome by the insertion of a low non-inductive resistance in series with the gap. This limits the current to an amount that, however great, is far less than the instantaneous value of that on a dead short circuit, which occurs when no resistance is used. This reduced current is not so capable of heating the arcing points to such a degree in the time available. As compared with the "non-arcing" arrester this type has the disadvantage of greater complication, and somewhat greater expense. It holds a decided advantage, however, in the decreased air space and consequent striking voltage. The resistance raises the required pressure to a certain extent, but much less than an extra gap wound, and, being non-inductive, offers but slight opposition to the lightning discharge. It is needless to call attention to the fact that

Fig. 1.

any circuit offering impedance is of no use for conducting any such discharge as lightning, and should be avoided absolutely in all apparatus, and installations of the same, when it would occur in the ground path of the system.

When it comes to the question of the protection of alternating current systems a different set of conditions arises. The voltages are always higher, are often as much as twenty-five times as high as the usual direct-current high-voltage systems. The current is not so easily affected by the magnetic blow-out, or more strictly, is not so easily made to generate its own field for use as a blow-out. These conditions require an arrester that will allow a discharge from the line at a potential which shall not be very much greater proportionately than the indicated normal line pressure, that will prevent any arc from following, and will admit frequent action for relatively long periods, with no appreciable heating, melting or increase of apparent resistance to the discharge. For example, let us imagine an ordinary 2000-volt electric lighting plant. The alternators are insulated to stand a normal maximum working pressure of 2500 volts, with a high potential test of from 5000 volts up, more often 5000 than "up." This insulation test is a factory test, and is made when the machinery is new and clean. After a few months' run the heat, dust and oil will cause material deterioration and the breaking down limit may be lowered several thousand volts. Allowing for the margin over the breakdown test at 5000 volts, we should never have this point lower than 4000 volts, with a 2000-volt dynamo after service has weakened it.

For the protection of this system we must have now arresters which will not operate at normal line voltage, to which must be added the possible increase due to resonance, but which will operate at a voltage not over 1000 volts increase. The striking potential of the gap must be therefore within 3500 volts and preferably considerably less, about 3000. This striking distance must remain constant and require practically the same voltage at all times, consequently it is required that no conducting vapors formed by the volatilization of the metal under the intense heat of the arc remain in the space between the electrodes to reduce the resistance of the path to the spark. Neither may it be allowed to employ the use of such arcing points as will be intensely heated, and in portions blown

out of position and shape. Fig. 1 illustrates the obvious reason for this, representing, as it does, electrodes before and after several discharges. The striking pressure in the first condition was 3300 volts and in the second 4700. This condition was the effect of four short circuits started by jumping a spark across the gap.

Any long continuation of this impairment would eventually throw the arrester out of operation and leave the machines unprotected.

This damage may be prevented, as above, by using non-arcing metals, or by cutting down the possible current at discharge. Again, as before, the non-arcing plan has its decided advantages, but the resistance plan possesses greater, the greatest being in the possible reduction of air space and consequent striking distance, so much so in fact that there are several systems in which an arrester operating at 4500 to 4700 volts will stand inoperative at 3000 volts and will not short circuit on discharge from lines carrying that pressure.

Direct current arresters may be of the same type for any one voltage, regardless of the use to which the current is put. Alternating-current arresters on the contrary are not all adapted to every system employed. An arrester that works well on simple lighting work will not do at all on heavy motor service, and in particular synchronous motor service. As an illustration of this let me cite some instances I noticed some years ago: A synchronous motor system was installed and there was used for protection against lightning a form of arrester which had a series of gaps directly from the line to the ground, while around this gap was a magnetic field formed by a coil in series with the main current from the line to the motor. When any "lightning" was on the line it was in every instance diverted by the arrester; the current followed, and an arc was established across two arresters of the system. These short circuited the motor, which, dropping out of step, generated a voltage differing in phase and frequency from the main line current. This difference acted in partial opposition to the current flowing through the blow-out field magnet and rendered it unable to rupture the arc. This arrester was therefore practically valueless for such work, and yet had proved entirely satisfactory for ordinary lighting service.

Any arrester for alternating-current work should preferably be in shunt to the ground, with no series coils as a part of the arrester, and in addition contain as few parts as possible, as little complication of action and as much clear space between extreme terminals as is consistent with safety and convenience combined. I would further suggest that, when purchasing arresters, it is as well to stipulate that no slate be used in their construction. Slate contains too many iron veins, and absorbs copper vapor too readily. The slight amount of metallic ingredient or deposit is often sufficient to cause surface leakage, which is soon apt to break into destructive arcing. An arc at 1000 volts, backed by sufficient current, will start over a surface at a distance which in the air would require often as much as 25,000 volts. This, of course, will occur only when the surface affords a certain amount of conductance.

So much for the arresters themselves. Whatever form of arrester may be selected must determine very largely the nature of the installation and the necessity for auxiliary appliances; and this again must be affected by the system employed, the service rendered, and the thoroughness of the installation "in toto." Three general cases may be considered and the adaptation to each case discussed briefly.

Let us consider first the simplest one. Ordinary lighting and small motor service. It will, of course, be necessary to protect the machines at the station, and, as usual, the installation of arresters in the tower is advisable for all but two reasons: The length of the ground wire is unnecessarily great, and the inaccessibility renders it less likely that they be examined frequently and increases the fire risk. On the other hand it is often the most convenient place, and there should be, without fail, an arrester on each line as near the dynamos as the circumstances will allow. The advisability of choke coils, banks of arresters, etc., will be mentioned in its relation to all cases. There should in the present case be distributed along the line, but by no means promiscuously, arresters, in such locations that they will serve as diverters at exposed places. There should without question be an arrester at each junction, at each group of transformers, and at any point where a considerable amount of current is distributed.

The distributed arresters should all be placed in accessible spots and arranged so that they may be systematically inspected at moderate expense. My experience leads me to believe that ordinary lighting systems are the only ones in which distributed arresters should receive favorable consideration, for the reason that the station apparatus is more completely under the control of the attendants, and because the amount of power on any one line is generally less than in power service.

Many times during a storm a transformer will break down between primary and secondary winding and thus introduce into the secondary system a dangerous voltage. There are several ways in use tending to lessen the danger in case this happens. The most common way is to ground the secondary in the middle. This removes the danger to life, but renders the transformer particularly liable to do the very thing the results of which we want to avoid, and is not a good method. Better results are obtained by using "earthing" devices. These are so made that when the potential in the secondary rises to from 300 to 400 volts two plates are closed into contact, and the system grounded. Both of these, however, are but remedies for what shoud preferably be prevented, and any method that will make it impossible for current to pass from primary to secondary windings is deserving of recommendation over both the preceding. This is accomplished in one case by interposing between the two coils a shield of copper heavily insulated with mica. This shield is connected to earth, and it is obvious will divert a breakdown in either winding to earth and away from the other.

Power transmission from a central station to one or more sub-stations requires protection at the main power house and at the sub-stations only. I should strongly discourage the idea that arresters scattered along the line are an advantage. The magnitude of the plants and amount of current used, together with the fluctuating loads, often render it impossible to tell for some moments when an arrester has broken down and is holding a fierce arc. This arc may in the few moments' lee-way allowed start a serious fire, a dead short circuit be formed, or other ways of interrupting the service ensue. In such systems let all arresters be under the eye of some vigilant watcher, and let the system be so arranged that the damaged arrester or circuit may be cut out at once.

A simple transmission of power from one power house to a single consuming station is, of course, but a modification of the second case, and even should it extend for miles let there be no arresters along the line. Such cases as the last two are particularly adapted to the application of the barbed wire scheme, and if the line is not guarded its entire length it should without question be so protected at all exposed sections.

The installation of arresters at the extremities of the lines is affected in every case by certain theories, or laws, or observed facts, or whatever we may individually wish to call them, and on the application of these theories often depends the success or failure of the entire arrester plan.

Electric Lighting in a Hurry.

That the lighting of electric lamps by the simple movement of a switch is quicker than the lighting of oil lamps is, of course, self-evident, but that the starting of a lighting plant is a quicker operation than the lighting of a few lamps may be a surprise to some. On a powerful tug-boat in use at one of the ore-shipping harbors near the head of Lake Superior, the crew has been greatly pleased with the promptness with which the whole craft can be lighted on emergency calls at night. On alarms of this kind, the engineer's first move after leaving his bunk is to open the throttle valve of the lighting engine and—the field rheostat being properly adjusted—the whole ship is alight by the time the simple toilet of the crew is finished, and the lines may be cast off. With the old method of lighting, either all the lights had to be left burning full strength or time had to be taken to go around and turn them up before starting, an annoying delay in some cases.

Reports of Interesting Electrical Undertakings in Russia.

The Russian Electro-Technical Society of St. Petersburg, the Russian name of which we will not attempt to give, owing to the difficulties of composition, has reorganized its official journal, a monthly periodical called the "Electro-Technical Messenger," which will in future give many original articles on interesting electrical subjects and descriptions of electrical work executed by Russian engineers.

Current Sources for Experimental Purposes.

The experimenter, and especially the amateur in electricity, often finds himself in difficulties with the ordinary forms of primary batteries upon which he relies for his current, both on account of the inherent perversity of batteries and because of his ignorance of their peculiarities. It is the purpose of this article to describe some cheap and simple forms of primary and secondary batteries which the amateur can easily make for himself and which will be found reliable and satisfactory.

For those purposes requiring a small steady current and for closed circuit work in general there is nothing better than the familiar gravity battery. The "crow foot" form is the best and cheapest. These batteries should be set up, a quantity of bluestone crystals sufficient to cover the copper being put in the bottom of the jar, and filled half full of a solution of the bluestone. Then pour in gently water lightly acidulated with sulphuric acid (about one part in twenty-five) over the zinc so that it floats on the top of the copper solution. The terminals should be at once connected together and the battery will be ready for use almost immediately. If the battery is simply put together and water put in on the copper sulphate crystals it will require a day or two to reach its normal working condition.

These batteries give an E. M. F. of about 0.9 volts and the usual three-quart size cell has an internal resistance of from 3 to 10 ohms, according to the condition of the fluids. The line of separation should be sharp. If the colorless upper fluid encroaches too far upon the blue lower solution some of it should be dipped out and strong copper sulphate solution added to the lower solution through a long-necked funnel. It will be found that a battery of these cells charging a simple form of secondary cell furnishes the most cleanly and convenient source of current for the amateur who occasionally has use for a larger current than can be conveniently obtained from the bluestone cells alone. A layer of paraffine oil, one-quarter inch thick, on the top of the fluid, prevents evaporation and the "creeping" of crystals over the edge, thus adding greatly to the cleanliness of the cells.

A simple and very convenient form of battery for powerful currents is made by taking a piece of sheet lead, say 18 inches square, and turning up the edges to make a shallow dish, say one-half inch deep. In this are laid about three thicknesses of blotting paper wet with a solution of sulphuric acid one part, potassium bichromate (by weight) one part and water eight parts. On the top of the blotting paper is laid a sheet of ordinary stove zinc slightly smaller than the lead dish. A battery of this sort of the dimensions described will give a current of about twenty amperes for a few minutes, but quickly polarizes and is therefore useful only for purposes requiring a strong current for a few moments. It should be dismounted immediately after use and the blotting paper returned to the jar of solution. A pad of cotton flannel is better than the blotting paper.

An excellent and reliable battery can be made as follows: Make a cylinder of copper wire gauze, about 18 or 20 meshes to the inch, 2½ inches in diameter and 6 inches long. The gauze is cut to the proper shape, bent around a round object of the proper size and fastened. The bottom of the cylinder is closed with a similar piece of gauze or a circular piece of sheet copper, which is better. Around the open top of the cylinder is soldered a stout ring of copper wire, about No. 12, which is extended to form one terminal. To the outside of the cylinder are fastened, with bicycle tire cement, six or more pieces of rubber bottle stopper, to prevent the gauze cylinder touching the zinc cylinder which surrounds it. This zinc is made of sheet zinc, cut to shape and rolled up to make a cylinder about 3½ inches diameter inside, a slot being left open along one side. A tongue of zinc should also be left for the attachment of the terminal binding post. This zinc cylinder should be about 6 inches high. The gauze cup is filled full of scales of black oxide of copper and the fluid consists of a solution of caustic soda in the proportion of 2 pounds to the gallon of water. Care should be used in dissolving the soda, as great heat is manifested. A layer of paraffine oil is an absolute essential in this battery. It gives an E. M. F. of only 0.75 volt, but is extremely constant, adapted to either open or closed circuit work and has a very low internal resistance. A cell of the size described will give about fifteen to twenty amperes on short circuit, showing an internal resistance of not more than 0.05 ohm. As these cells can be conveniently made of large size they form a very convenient source of considerable currents, and as they give off no fumes and last indefinitely on open circuit they are to be highly recommended for the use of the amateur.

For most purposes, however, a storage cell has many advantages, especially when used in connection with a battery of gravity cells continually charging it. One of the easiest forms to construct is made as follows: A battery jar is provided with a porous cup about three-fifths the diameter of the jar, and both cup and jar are filled to the same height with fragments of broken carbon, carbon rods imbedded in the mass of broken carbon in the jar and cup serving as terminals for the introduction and withdrawal of current. Both jar and cup are filled to the same height with a saturated solution of neutral sulphate of soda, which under the action of the charging current is electrolyzed into sulphuric acid and caustic soda. These mixing through the porous walls of the cup give rise to a powerful but short lived current, but the cell is so simple and cheap that this disadvantage is a small one. Like the other cells described it should have a layer of paraffine oil floated on its solution to prevent the crystallizing of the salts.

A similar cell was recently described by a Spanish writer in "Revista des Obras Publicas," the difference being that the solution is of sal ammoniac, which electrolyzes into ammonia and chlorine, the latter becoming hydrochloric acid through reaction with the water. Great steadiness of action and enormous output for the size of cell are claimed for this arrangement, but it has many disadvantages, evil smells not being the least. The soda sulphate cell gives an E. M. F. of 2.4 volts at full charge and a current depending, of course, on its dimensions. One made of an ordinary 8-inch battery jar ought to give something like ten amperes for half an hour on discharge, the E. M. F. falling to about 1.5 volts as the discharge proceeds. In connection with a charging battery this is a very convenient cell, as it requires no attention whatever; but it cannot be left on open circuit, as the solutions mix through the porous cup and soon discharge the cell.

An excellent and cleanly type of cell is made of lead plates in a solution of the sulphates of zinc, cadmium and magnesium. The plates are best assembled in the usual manner, an odd number being used and alternate ones connected together. The thickness of the plates need be only sufficient for mechanical strength. All the plates that are to be used as negatives should be lightly amalgamated by being rubbed with an acid solution of mercury nitrate; or zinc plates may be used, but are not so good as the amalgamated lead. The solution should consist of 1 pound of zinc solution, 1 pound of cadmium sulphate and 2 ounces of magnesium sulphate to the gallon of water. The cadmium sulphate may be replaced by zinc sulphate, but this makes the action of the cell rather uncertain and its discharge rate smaller. The capacity of the cell increases after repeated chargings and dischargings, the E. M. F. falling from 2.4 to about 2.1 volts during discharge. Its capacity is about 150 watt hours per pound of plates at a discharge rate of about seven amperes per pound. This cell does not last well on open circuit, but by reason of its steady and powerful discharge is a very useful type in the laboratory.

By using the same arrangement of lead plates in a solution of sulphuric acid one part and water ten parts a Plante cell can be made by repeatedly charging and discharging the plates. This is rather a slow process, and for the purposes of the amateur either the soda sulphate or zinc-cadmium-magnesium type is better. For operating a small motor, for example, a good arrangement would be four cells of the latter type, each having fifteen plates 8 inches square, connected to twenty-four large bluestone cells (4-quart size), the latter being arranged in two series of twelve each.

Electricity Put to Shame by Gas.

The street gas lamp posts in Liverpool have been fitted with water heaters and penny-in-the-slot machines by which hot water can be obtained in small amounts, the waste heat of the gas being utilized in this way. In this respect the electric light will probably have to yield the palm to its rival, as the luminous efficiency of the electric lamp is so much greater that the waste heat per candle-power is too small to be of use.

What's in a Name?

A good example of inventive genius is shown in the following list of names for the same thing: The vitascope, cinematograph, kinetoscope, animatograph, projectoscope, biograph, theatroscope, cineograph, veriscope, magnigraph, theatriscope and warograph.

The Missouri-Edison Plant in St. Louis.

BY GEORGE J. PERCIVAL.

IT was about eleven years ago that Guido Pantaleoni (representing the Westinghouse Electric Company) brought to St. Louis a 25-kw alternating dynamo, together with a full complement of converters, etc., all patterned after the Gaulard & Gibbs apparatus installed in the Grosvenor Art Gallery, London.

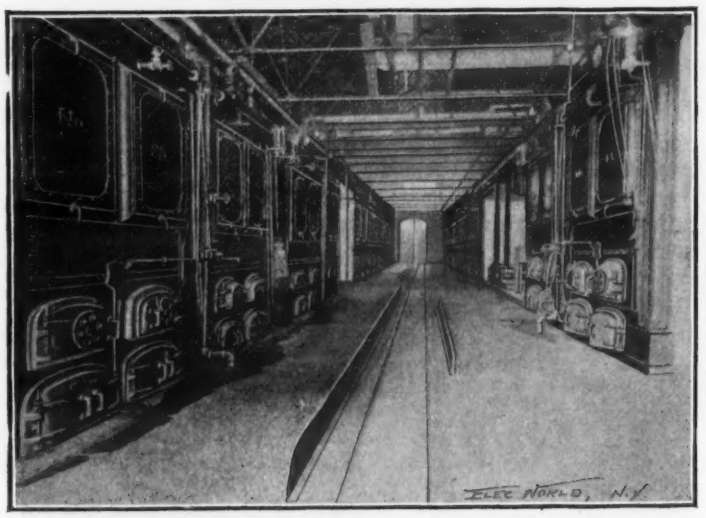
This was the advent of the induction system in St. Louis, and the beginning of a new era in house-to-house distribution; for up to this time the Heisler series constant-current system was the only one in operation, and that on a limited scale. There were many obstacles to overcome before the new system became established, but from 1888 up to the present year, a period of ten years, it has steadily gained favor, and to-day it bids fair to displace entirely the direct-current system for all purposes.

Some idea of the enormous growth of this system may be obtained from the following statement: In 1888 the capacity of the plant was 500 16-cp lamps; to-day it is 174,265 16-cp incandescent lamps, 3575 alternating arcs, 1036 direct-current arcs, and 2390 horse-power in electric motors.

The present plant of the Missouri-Edison Electric Light & Power Company consists of three stations, A, B, and C. Station A formerly belonged to the Missouri Electric Light & Power Company, Station B to the Edison Illuminating Company and Station C to the St. Louis Electric Light & Power Company.

The equipment of the Missouri-Edison Company is very varied, the following systems being operated on its lines: Incandescent lighting at 110 volts; series and multiple arc lighting, direct and alternating; power for motors at 250 and 500 volts direct current, and at 110 to 250 volts alternating.

Although in 1884 Ferranti demonstrated in his Deptford plant in England that direct connection was not only practical but desirable, it was not until the year of the World's Fair at Chicago that any attempts were made to employ it in the city of St. Louis. Up to 1894 all apparatus was belted, and required vast amounts of floor space. The largest single unit employed up to 1892 was 180 kilowatts, in 1894 350 kilowatts, but in 1895 came the present 1000-kw Westinghouse and General Electric direct-connected units.



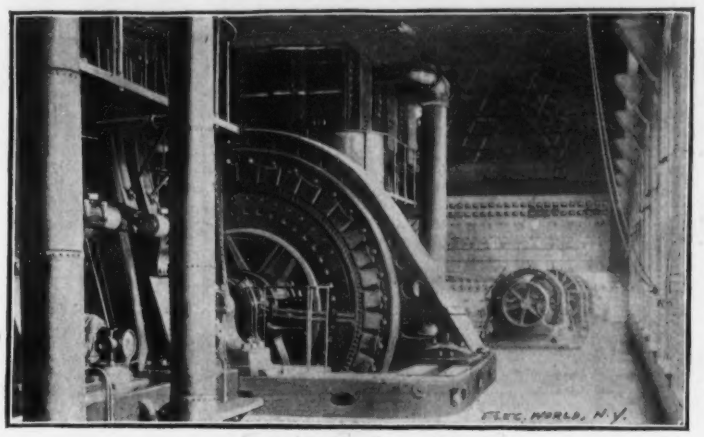
BOILER ROOM, STATION A.

The following is a brief description of each of the three stations, mentioning only the general features:

Station A, shown in the initial illustration, is located at Twentieth and Locust Streets, and contains the following apparatus:

A steam-generating plant, consisting of eighteen Babcock & Wilcox water tube boilers capable of evaporating 130,000 pounds of water per hour.

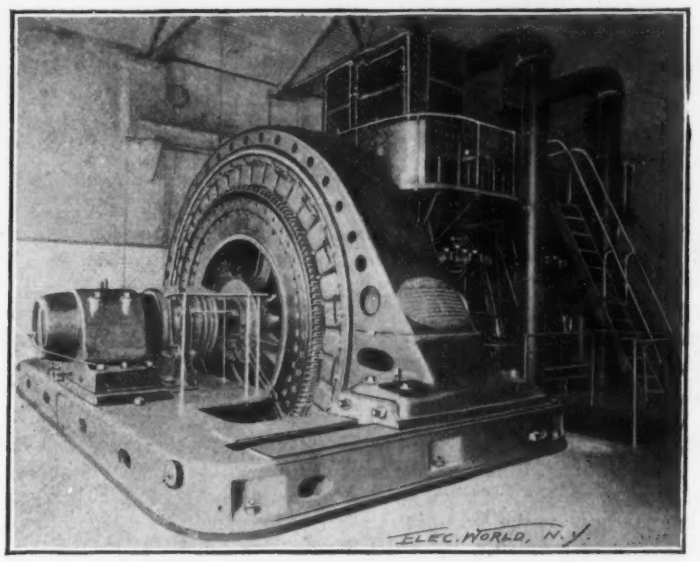
An electric plant, consisting of three Westinghouse alternators,



WEST SIDE VIEW, STATION A.

each of 1000 kilowatts, connected direct to three Lake Erie compound three-cylinder engines, each capable of developing 1500 horse-power; one 200-kw National, and one 200-kw Westinghouse 500-volt generators belted to compound Westinghouse engines of 300 horse-power each; six 180-kw Westinghouse alternators belted to six Westinghouse 300-hp compound engines; one 350-kw Westinghouse alternator belted to a Westinghouse compound engine of 600 horse-power; three exciters, two of 75 kilowatts, Westinghouse make, and one of 100 kilowatts, General Electric make, direct connected to suitable compound Westinghouse engines. Steam is conveyed at 150 pounds' pressure to the dynamo room by two overhead mains, 22 inches in diameter. The exhaust pipe is 36 inches in diameter, passing through Berryman heaters and a small surface condenser on the roof, which secures a return of 25 per cent. of the water.

The switchboard extends the entire width of the building, and is located at the extreme south end. It is built entirely of iron and marble, so as to insure that it shall be thoroughly fireproof. It contains all the measuring and switching devices, circuit boosters and circuit breakers.



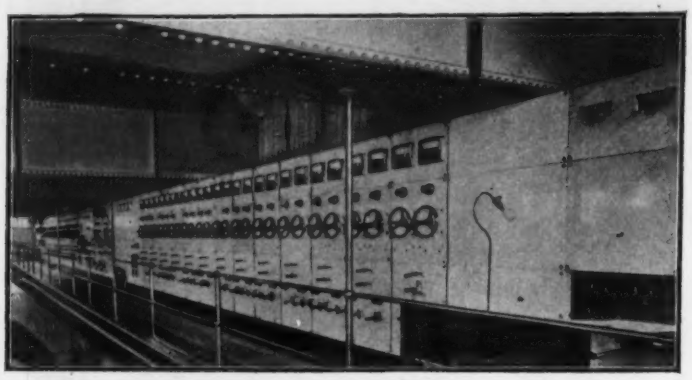
1000 KW UNIT, STATION A.

This plant supplies all the commercial alternating-incandescent lighting and 500-volt motor work. It operates daily from 6 P. M. to 6 A. M., and twenty-four hours on Sunday. All alternating current leaves the plant at 1000 volts' pressure and 7200 alternations.

Station B is located at Nineteenth and Gratiot Streets, and contains the following apparatus:

A steam generating plant, consisting of twelve Heine water tube boilers capable of evaporating 126,000 pounds of water per hour.

An electric plant, consisting of two General Electric 1000-kw monocyclic alternators, one being coupled direct to a 1500-hp simple Hamilton Corliss engine, the other to a 1500-hp cross compound engine of the same make; one 500-kw, 500-volt General Electric direct-current dynamo coupled direct to a 750-hp simple



Switchboard, Station B.

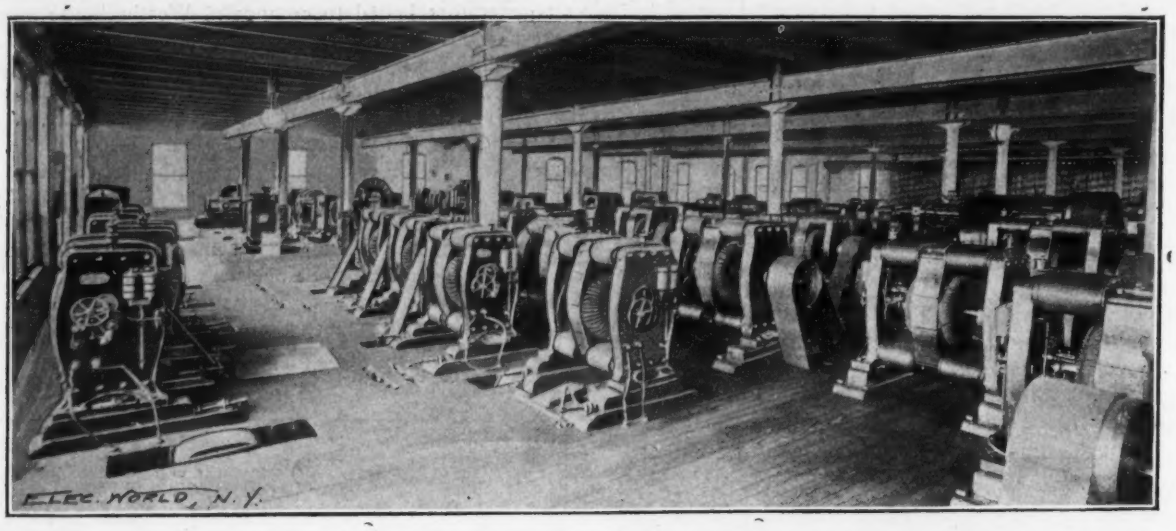
Hamilton Corliss engine; thirty constant-current Wood arc dynamos and two 500-volt direct-current generators, 100 kilowatts each, belted by means of jack shafts to four simple Hamilton Corliss engines, aggregating 2000 horse-power; two direct-connected exciter boilers, 72 inches in diameter, capable of evaporating 27,000 pounds of water per hour.

An electric plant, consisting of six Edison bipolar shunt-wound dynamos—two of 80 kilowatts and four of 30 kilowatts—all 250-volt machines and belted to three Russell four-valve simple engines of 150 horse-power each. There are also two other Russell four-valve engines of 300 horse-power each, not connected to any dynamos. The switchboard in this station, being for 250 volts direct current, is very simple and complete.

It will readily be seen that stations A and B are by far the most important. They are 1 mile from each other, and are so designed that in case of accident or fire no delay in service shall occur. In a very few months all direct-current arcs will be abolished, when the two plants will be duplicated so far as operating systems are concerned, and the load may be shifted from one to the other at will.

As rapidly as men can make the requisite changes all 250-volt motors are being rewound for 500 volts, connection then being made onto the 500-volt regular power line, so that eventually station C may be given up as a generating station, leaving stations A and B to furnish all the current supply.

None of the stations are operated condensing, although it would appear suicidal to do otherwise in a city where water costs so much as in St. Louis, 12½ cents per 1000 gallons being the minimum rate. It would seem as though greater economy could be obtained if a system of cooling towers were employed; for the experiment made at station A, by simply using two large headers, joined to-



Third Floor View in Station B.

dynamos of 100 kilowatts coupled to two vertical compound Westinghouse engines of 120 horse-power each.

As at station A, steam is employed at 150 pounds' pressure, and is distributed to the various engines by two pipes underground, one a main of 24 inches diameter, and an auxiliary of 18 inches diameter, cross connected, so that any section of pipe can be removed without in the least affecting the operation of the plant. The exhaust pipe is 36 inches in diameter, and is also placed underground, passing through Baragwanath heaters and out to the roof.

The switchboard is similar to that at station A, both these boards being built throughout by the Wagner Electric Manufacturing Company, of St. Louis. They are so arranged that any combination of circuits can be switched to any dynamo, and so that either station can operate the load of the other. Each feeder is fitted with an independent regulator, by which its voltage can be raised or lowered.

The two stations are connected together by tie lines of 1,000,000 circular mils cross section. Station B operates twenty-four hours per day on week days and shuts down on Sundays. The total capacities of these stations may be summed up as follows:

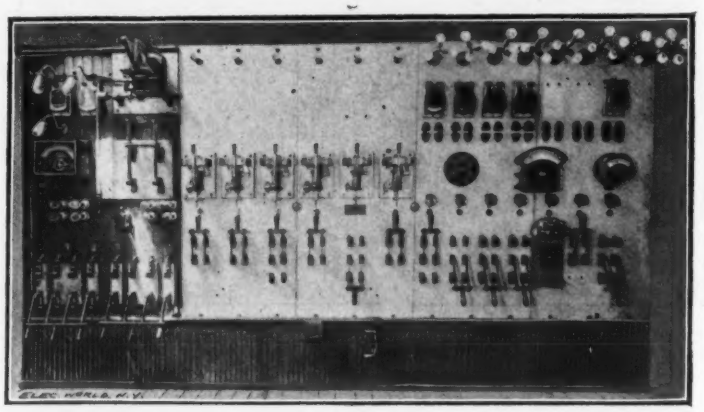
Station A, dynamos, 4730 kilowatts; engines, 7560 horse-power; boilers, 4320 horse-power.

Station B, dynamos, 4430 kilowatts; engines, 6540 horse-power; boilers, 4250 horse-power.

The last plant to be described is station C, located on Christy Avenue, between First and Second Streets. In it is contained the following apparatus, all for power service:

A steam generating plant, consisting of six horizontal tubular

gether by means of lateral 2-inch pipes to secure a large condensing surface, returns for use again 25 per cent. of the present water



Switchboard in Station C.

consumption. Station A has consumed as much as 25,000 cubic feet of water in twenty-four hours, which means 187,500 gallons, costing $23.50, of which at least 90 per cent. could be saved. The annual consumption of stations A and B is nearly 77,000,000 gallons, the coal consumption of each averaging about 100 tons per day.

For the distribution of the current 228 miles of pole lines are in

use with 1596 miles of conductors, and 30 miles of underground conduit (composed of 800,000 feet of 3-inch ducts) have been laid, a full account of the method of laying these conduits having appeared recently in these columns.* In the conduit district (comprising about 2 square miles), converter sub-stations will be located at frequent intervals in underground man-holes; current to be taken from the station mains at a primary pressure of 1000 volts and transformed down to 110 and 220 volts, with local feeders as distributers of current on the three-wire system having 220 volts between terminals. The extreme distance to which current is supplied is 6 miles in any direction from the station.

An experiment is being made at station A to obtain an automatic system of oiling by means of pressure pumps. Both cylinder and lubricating oils are conveyed to sight feed and automatic oil cups by means of four Worthington pumps, two for each kind of oil. All that can be saved is returned to tanks and filters located between foundations of engines and dynamos, beneath station floors. No oil cans whatever are necessary, nor are there any oilers, and waste is dispensed with entirely. This system of automatic oiling is of local origin, the inventor being John H. Siegrist, Jr.

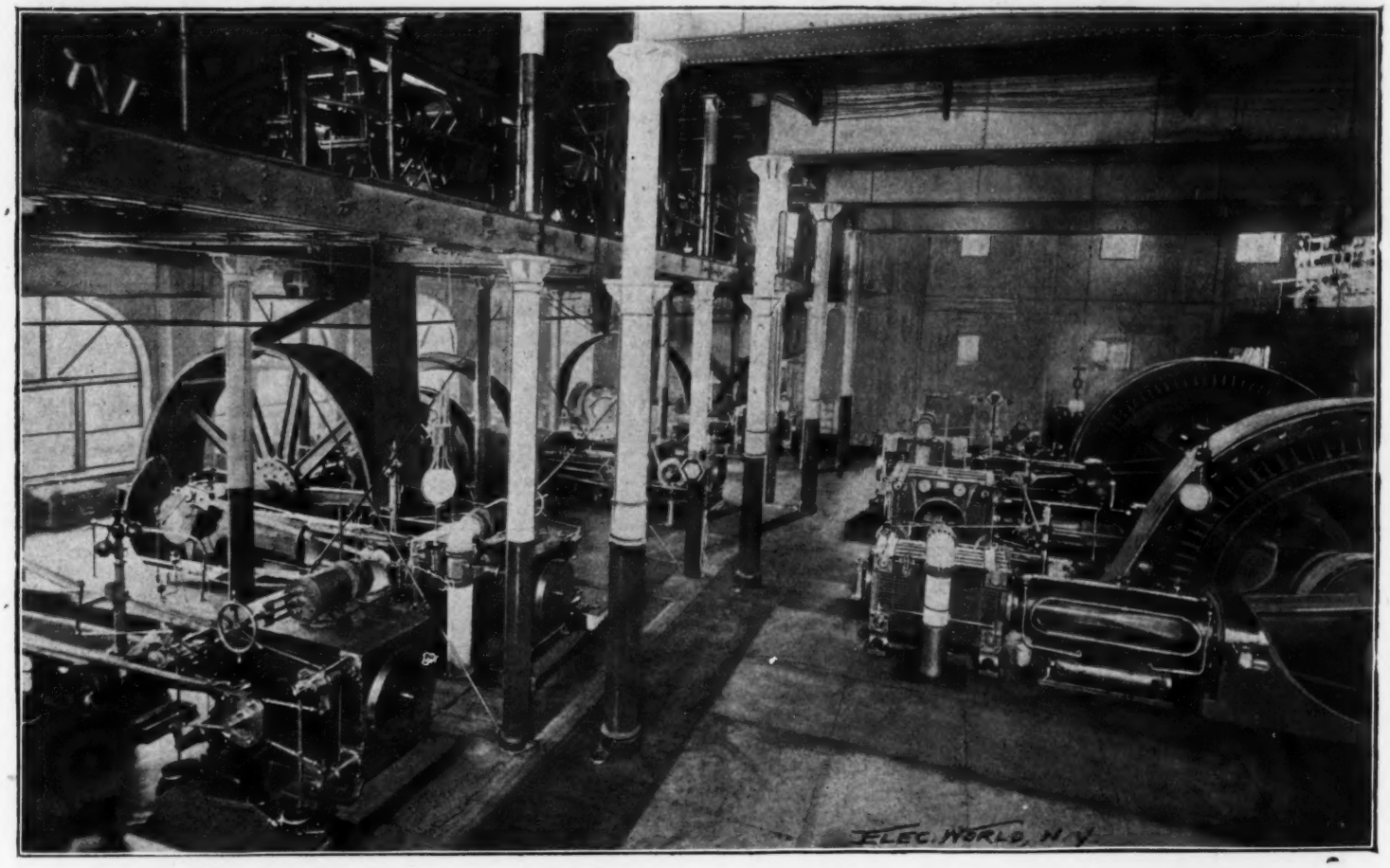
Each of the large stations has its own machine, blacksmith, and repair shops, no outside assistance being necessary, even for boiler and engine repairs. At station A a well-appointed laboratory and testing room is located, where careful records are kept of anything submitted requiring electrical energy.

The sale of current is based upon quantity consumed, varying for incandescence from 1 cent to half a cent per 16-cp lamp hour of 50 watts, all such current being measured by Shallenberger integrating ampere-hour meters. For arc lamps a general flat rate of 5 cents per lamp hour is charged, and for power the average rate is 5 cents per hp hour. Some attempts have been made to introduce cooking and heating apparatus, but so far no specific success has been attained.

The gradual growth of the output of this company will be obvious at a glance at the following table, which shows the increase in business from January 1, 1890, to January 1, 1898. It should be explained in connection with this table that up to 1894 the Missouri Electric Company operated only incandescent lights. It was during that year that the business of the Municipal Company was acquired, though operated as the Edison Illuminating Company. The Edison Company's business had been chiefly arc and power service. The decrease in the D. C. arc column, in 1897 and 1898, shows the speed at which the A. C. arcs are displacing those using direct current:

Year. Jan. 1.	Incandescent Lamps.	Arc Lamps. A. C.	Arc Lamps. D. C.	Motors. H. P. Capacity.
1890	18,910	0	0	0
1891	32,508	0	0	0
1892	57,436	0	0	0
1893	73,140	0	0	0
1894	111,940	20	3306	648
1895	126,475	250	3144	696
1896	144,144	620	3055	1117
1897	156,728	1668	2482	1239
1898	174,265	3575	1036	2390

Under the contract made with the city in 1890 Wood D. C. arc lamps were employed in series. These are now being rapidly rewound for alternating current and equipped with laminated cores, and continue to run in series as before. A notable feature in this connection should not be overlooked; with the direct-current series system open circuits, due to defective lamps, frequently occurred; this cannot happen with the alternating system, for a reactive coil is shunted across the terminals of each lamp, and remains constantly connected. During the proper operation of the arc lamp very little energy is taken by the coil, but should the lamp be deranged the shunt becomes useful, and until remedied absorbs an amount of energy nearly equal to the lamp. By this means an open circuit can only occur through a break in the line, which can be speedily located.



GROUND FLOOR VIEW, STATION B.

To keep the proper flow of 10 amperes on the line constant under varying conditions of load, another impedance or reactive coil is placed at the station in series with each line. This has a movable core, by means of which and special transformers located under the switchboard combinations of connections can be made varying the pressure on the line from 100 to 4000 volts, as may be found necessary. Thus A. C. arc lamps are operated in groups of twenty to eighty in series, and upon one of the monocyclic generators the entire load of upward of 2500 lamps is carried nightly. For those readers who are engineers and central station managers the following details of the machines may prove of value:

Engines—

Type, 1500 hp 3-cylinder compound vertical; cylinders, high pressure, 25 in., low pressure, each, 34 in.; stroke, 24 in.; r. p. m., 180; piston speed, 720 ft.; diameter of shaft, 18 in.; total height, 15 ft.

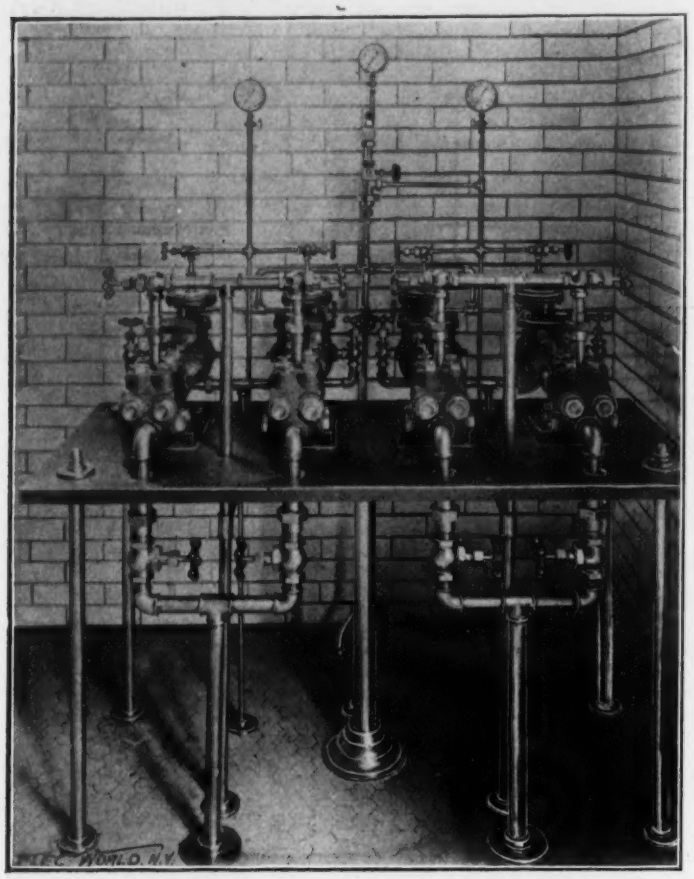
* See THE ELECTRICAL WORLD of August 21 and 28 and September 4, 1897.

Manufactured by Lake Erie Engineering Works.

Type 1500-hp 2-cylinder cross compound horizontal; cylinders, high pressure, 26 in., low pressure, 42 in.; stroke, 54 in.; revolutions, 90; piston speed, 810 ft.; diameter of shaft, 22 in.;

Manufactured by Hoover-Owens & Rentschler Company.

Type, 1500-hp simple Corliss horizontal; cylinder, 30 in.; stroke,



Oil Pumps for Automatic Lubrication, Station A.

60 in.; piston speed, 900 ft.; revolutions, 90; diameter of shaft, 22 in. Manufactured by Hoover-Owens & Rentschler Company.

Type, 750-hp simple Corliss horizontal; cylinder, 26 in.; stroke, 54 in.; piston speed, 810 ft.; revolutions, 90; diameter of shaft, 18 in.

Manufactured by Hoover-Owens & Rentschler Company.

Type, 550-hp compound single-acting vertical; cylinders, high pressure, 22 in., low pressure, 36 in.; stroke, 22 in.; revolutions, 210.

Made by Westinghouse Machine Company.

Type, 300-hp compound single-acfing vertical; cylinders, high pressure, 16 in., low pressure, 27 in.; stroke, 16 in.; revolutions 250.

Made by Westinghouse Machine Company.

Generators—

Type, 1000-kw alternating-current stationary field; armature diameter, 10 ft.; speed, 180 revolutions; weight of armature 80,000 lbs.; diameter of shaft, 18 in.; field poles, 40; frequency, 60 cycles; winding 2-phase, 1200 volts.

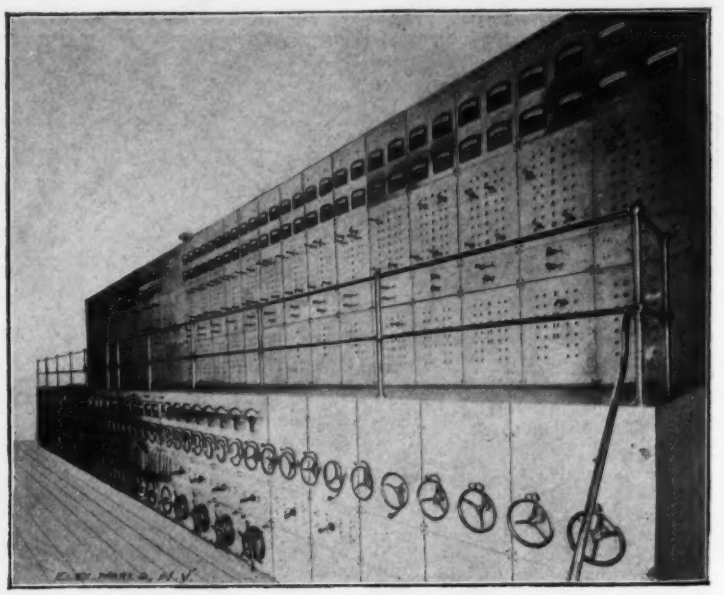
Made by Westinghouse Electric & Manufacturing Company.

Type, 1000-kw alternating-current stationary field; armature diameter, 16 ft.; speed, 90 revolutions; armature weight, 100,000 lbs.; diameter of shaft, 22 in.; field poles, 80; frequency, 60 cycles; winding monocyclic, 1200 volts.

Made by General Electric Company.

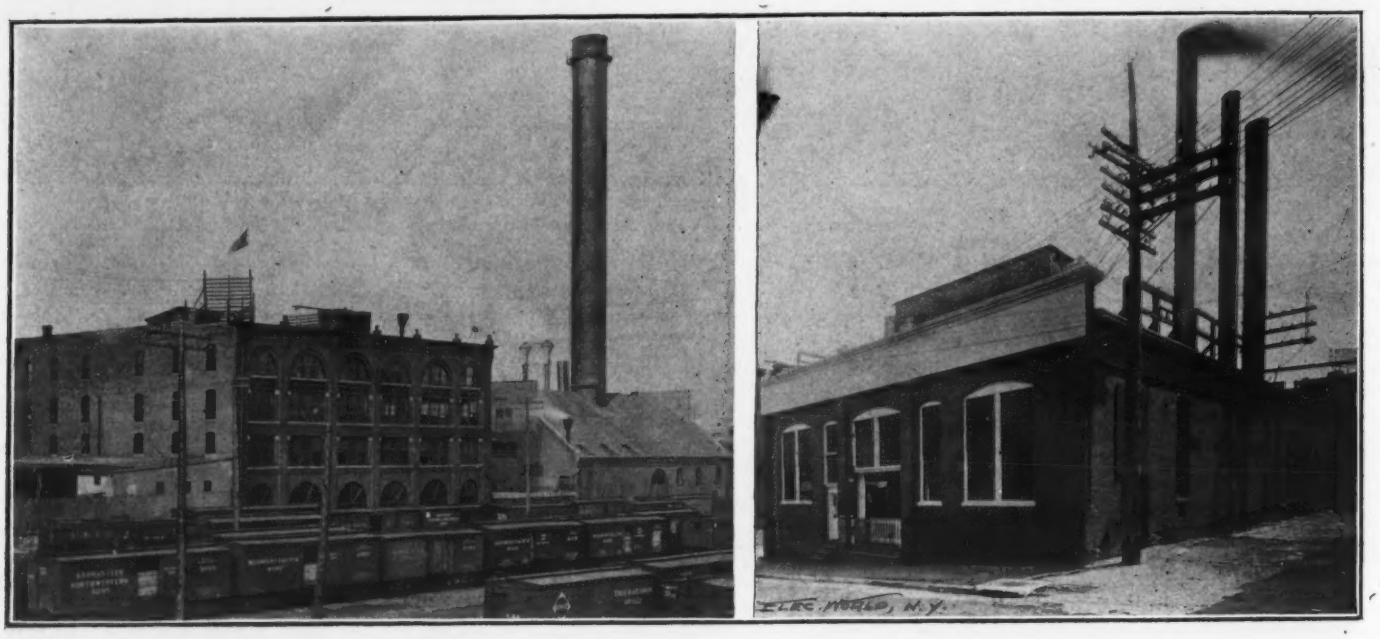
Type, 500-kw direct-current, 500 volts; armature weight, 32,000 lbs.; total weight, 76,000 lbs.; diameter of shaft, 18 in.

Made by General Electric Company.



Switchboard in Station A.

No complicated devices are to be found anywhere in this plant; extreme simplicity abounds and stability is everywhere obvious. The engineering work throughout has been done by H. A. Wagner, who is the engineer and superintendent of the plant; and in a great measure the success of the enterprise is due to his indefatigable efforts; it is a representative alternating central station, and of considerable importance because of its capacity; it is also a silent though ponderous and unquestionable witness to the rapid and wonderful improvements made during the past decade.



Station B.

Station C.

DIGEST
OF CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering

Dynamos, Motors and Transformers.

UNINSULATED ARMATURE BOLTS. Boucherot. "L'Ind. Elec.," May 10.—In a recent article by Fischer-Hinnen (see "Digest," April 23,) the question of whether the bolts for clamping together the plates in armatures should be insulated or not was discussed; the present author arrives at somewhat different conclusions. A French constructor would in most cases insulate the bolts, while a Swiss constructor would not; the question arises which is right; uninsulated bolts should never, except in possibly very rare cases, heat a machine sufficiently to reject it, nor would they lower the efficiency sufficient to make the machine a bad one. He then discusses the question mathematically, developing some formulas with which he claims it is very simple to determine in each case whether the bolts should be insulated or not; he bases his formulas on the flux which passes through the bolts, and their distance from the outside of the armature is therefore an important factor; formulas are given, which cannot be reproduced here, and an example is worked out; with these he claims it is a simple matter to find by the inspection of the design whether it is necessary to insulate the bolts or not. He concludes that it is the induction "above" the bolt which determines the intensity of the current in the bolt; when this is less than 10,000 gausses only a small current will be generated in the bolts, but it will increase rapidly as the induction exceeds this. He gives the folowing rule: "All the flux of an inductor being supposed to pass through the part of the discs at the exterior of the bolts, it is useless to insulate the bolts when the induction in this part, above each bolt, does not exceed 10 to 12,000 gausses." This explains the difference of opinion between Swiss and French constructors; in an alternator, which is the more common machine in Switzerland, the induction rarely exceeds 10,000 gausses, while in a continuous current dynamo, on the contrary, it almost always exceeds this, inductions of 15,000 to 17,000 being quite frequent; it is therefore in continuous current machines where current in the bolts need be feared more than in alternators.

NON-SYNCHRONOUS POLYPHASE MOTORS.—"Brunswick. L'Elec.," May 14 and 21.—The beginning of an article describing the Boucherot system, which has already been referred to in these columns (see "Digest," April 16, February 19 and 26). The first part is general in character; in the second installment he gives an illustrated description of the motor and its action. The difference of phase is varied in two series of polyphase circuits connected in parallel to a fixed resistance; the advantages claimed are the avoidance of all contact rings and brushes; the absence of complicated parts in the revolving portion for starting; they may be started under the most severe conditions; the current at starting is directly proportional to the starting torque; no starting accessories like rheostats, etc., are required; there are no coils in the moving part, which is a mere squirrel cage armature; the heating is reduced to a minimum; starting is accomplished by merely closing the switch; and finally the efficiency and power factor are high. The article is to be continued.

STARTING SINGLE-PHASE MOTORS. Kolben. Aichele. "Elek. Zeit.," May 19.—Replies to the recent one by Arno in the discussion regarding the latter's system of starting single-phase non-synchronous motors.

MAGNETIC SHIELDING. Du Bois. Lond. "Elec.," May 20. —The sixth and last installment of his long serial. The article is of a mathematical nature; no general conclusions are drawn. The principal application of current shielding is found in slot and tunnel wound armatures; the relation of the total force in the tunnel to the induction in the surrounding iron is investigated for differently shaped sections; practically the whole of the drag is transferred from the buried conductors to the surrounding iron, and the formation of eddy currents in the former is much reduced; the lines of force bridging the air gaps are slightly inclined to the radial direction and thus exert a tangential drag which may be very great. Illustrations are given of the distribution of the lines in the air gaps with tunnel and slot wound armatures of different kinds.

CURRENT TRANSFORMERS. Child. "Elec. Eng.," May 26.—The first article of a series. After a general discussion, in which he refers chiefly to each of the numerous methods of transforming currents, both alternating and direct, he begins a more detailed description of three of the methods, namely, the motor driven dynamo, the single and double winding rotary transformer, and the Hutin and Leblanc "panchahuteur," with special reference to their application to large currents when a direct current of greater smoothness than the pulsating variety of the rectifier are required; these are all for transforming alternating into direct currents. Either the synchronous or the induction motor may be used for the motor driven dynamo, but the latter is seldom used for large sizes, on account of the low power factor and because its speed depends on the voltage and is therefore liable to variation; the synchronous motor can always be made to have unity power factor by proper excitation, and its speed depends only on the frequency; moreover the line voltage without transformation may be used for the armature when it is the stationary part; the disadvantages are high cost and comparatively low efficiency as compared with the single winding rotary transformer; also its lack of self-starting ability; its advantages for most classes of work are very great; an efficiency of over 85 per cent. at full load may be obtained. In the combination of the two machines into one by using a single field many desirable features are sacrificed; such machines, especially in large sizes, are unsuited for any but the lowest frequencies.

Lights and Lighting.

CATHODE RAY LAMP. Swinton. Lond. "Elec. Rev.," May 20.—A very brief reference to this lamp, which was shown to the Royal Society. "Two concave cathode discs focus on a cube of refractory material, and give out sufficient light to illuminate a small room. The efficiency of this method of producing light is considered to be quite equal, if not greater, than that of the arc light." (This is all the information that is given.)

LIGHTHOUSE. Preller. Lond. "Engineering," May 20.—The conclusion of his very complete illustrated description of the lighthouse at Penmarch (see "Digest," May 28). In describing the optical apparatus he states that the ratio of increase of luminous power is much smaller than the increase of electrical energy required, for which reason double instead of single apparatus for the most powerful flash lights will in future be adopted by the French lighthouse department; a table shows that as the electrical energy is increased in the ratio of 1 to 2 to 4 the luminous power is increased in the ratio of 1 to 1.5 to 1.9; moreover 25 amperes at 45 volts, with 10 mm carbons, gave a light of 12,000,000 candles in the beam; the twin apparatus at 50 amperes in each lamp will therefore be more economical and have a greater luminous power than a single apparatus at 100 amperes; this principle has for the first time been carried into effect in this lighthouse. The minimum, maximum and mean luminous power of the combined beam is given; the mean for 10 mm carbons is 23,200,000, and for 16 mm carbons 35,000,000. This is the most powerful lighthouse in existence.

HEAT COMPENSATOR FOR AN ARC LAMP.—"Elek. Zeit.," May 19.—An illustrated description of an apparatus for compensating for the increase of resistance in the shunt regulating coils of the Koerting and Mathiesen arc lamp. The voltage at the terminals of the arc is dependent to quite an extent on the heating of the shunt coil, and the present apparatus is intended to compensate for this, making the regulation more accurate. The device consists of a number of pairs of tubes made of zinc and iron and so connected together that the differences of expansion due to heat are added together; this combined expansion moves the end of a lever, which acts on the regulating device in such a way that the error produced by the heating of the shunt coil is compensated.

PORTABLE FOCUSING LAMP. Betz. "Elek. Anz.," May 12.—A brief, illustrated description of such a lamp.

STANDARD SCREW SOCKETS. Hundhausen. "Elek. Zeit.," May 19.—An illustrated reprint of the report of the committee appointed by the Union of the German Society of Electrical Engineers, on the proper standard screw thread for the base and sockets of incandescent lamps.

Power.

WATER POWER INSTALLATION IN DALMATIA.—"Elek. Zeit.," May 19, and "Zeit. fuer Elek.," May 15.—A brief description of a proposed 5000-hp water power installation in a locality where only electrical transmission could be used.

AUXILIARY MACHINES. Compere. "L'Ind. Elec.," May 10, "L'Eclairage Elec.," May 21, and "L'Elec.," May 21.—An abstract of a paper read before the French Society of Civil Engineers, in which he gives the results of tests made of auxiliary machinery in various installations, in order to determine the consumption of steam; it shows the relatively very great steam consumption of such machines; in conclusion he refers to an installation in which all such auxiliary machinery is operated electrically.

ELECTRIC AND STEAM DRIVEN PUMPS.—Lond. "Elec. Eng.," May 20.—Brief replies to a request to give the relative advantages and disadvantages of an electric and steam driven feed pump, including data.

GRAIN ELEVATOR.—"L'Eclairage Elec.," May 21.—A brief description of the one at Copenhagen, which is similar to the one in Buffalo, N. Y.

Traction.

ACCUMULATOR TRACTION. Sieg. "Elek. Zeit.," May 12. —An abstract of a paper read before the Electrical Society of Cologne; in the abstract brief references are given to a number of different existing installations. A car has been in use on a steam rail-

way near Stuttgart; it weighs 26 tons, contains 188 accumulators, having a capacity of 16 kw hours; it will seat forty-eight passengers, will run at a speed of 35 km per hour, and consumes 20 watthours per ton km (whether at the motors or at the switchboard is not stated). Large accumulator cars have been running for some time in Paris; they carry fifty-two passengers and have two motors of 25 horse-power each, weighing when fully loaded 14 tons and containing 200 cells, weighing 3600 kg; accurate measurements show that the average current consumption is 860 watt hours per car km, referring to the charging current. Several other cars in use are referred to, but the data are not given in the abstract.

PARIS.—"L'Ind. Elec.," May 10.—An extract from a French journal giving a classification of the methods of railway traction used in Paris. About 30 per cent. of the length of lines are operated by mechanical means, as distinguished from horses; the same ratio holds good for the total number of vehicles; electricity is used on only six of the fifty-seven lines; that is, on scarcely 10 per cent. The total length of lines operated mechanically is 84 km, of which over 34 km, or nearly half, are operated by compressed air; the total number of cars is 211, of which forty-seven are operated by compressed air and fifty-one by accumulators, on thirty-five cars of which the rapid charging system is used. The length of lines operated by horses is 208 km, and the number of cars 478.

TRACTION PROJECTS FOR THE PARIS EXHIBITION.—Lond. "Elec. Rev.," May 20.—A brief abstract of the article noticed in the "Digest," March 26.

KIDDERMINSTER AND STOURPORT RAILWAY.—Lond. "Elec. Rev.," "Elec." and "Elec. Eng.," May 20.—An illustrated description of this line, which has just been started, one of the interesting features of which is claimed to be that the equipment was worked out by British inventors. The trolley wires are on bracket poles on the side of the street, the wires for both tracks being on the same pole and therefore not over the cars, but decidedly to one side, the trolley pole being inclined about 45° to the rear and to the side, for the outside of the two cars.

SURFACE CONTACT SYSTEMS. Pellissier. "L'Eclairage Elec., May 21.—In this continuation of his long series of articles he gives a full, well illustrated description of the Thomson-Houston system, taken apparently from patent specifications.

BALTIMORE. Fairchild. "Elec. Eng.," May 26.—A short article of a general character on the electric railways in that city; the plant and the discipline are briefly described and the municipal requirements are stated.

Installations, Systems and Appliances.

STARTING GAS MOTORS. Leroy. "L'Ind. Elec.," May 10.—In France the number of electric lighting installations run by gas engines is increasing, and the question of starting the engines becomes an important one; in these installations, accumulators are very frequently used, partly as a means of storage and partly to dampen the impulses due to the irregular speed of the engine; these accumulators can therefore be used together with the dynamo as a motor, for starting the engines. A system for doing this is described; a diagram gives the connections and shows a double resistance, one for the field and another for the armature current, both of which are gradually cut out by the same lever; there should be no compression produced in the cylinder when the engine is first started. Some data are given showing the amount of energy consumed; in one installation there are five engines of 45 horse-power each, and they require for a sure start 90 to 110 amperes at 110 volts; there being no compression; the time necessary for getting up to a sufficient speed to make sure of the start, does not exceed 25 to 30 seconds; in another installation an engine of 25 horse-power connected with a long, heavy transmission with belts, the current required was 70 amperes at 110 volts; a 50-hp engine required 80 to 90 amperes and a 25-hp engine 50 amperes, the time being 20 seconds. In general, therefore, it takes about two-fifths of the total power of the engine to start it and the dynamo, but the time during which the current is required is so short that the energy is practically an insignificant amount. A single rheostat will suffice for starting a number of dynamos and engines by properly connecting them with the switchboard, as is shown in a diagram.

COMBINED SINGLE AND TWO-PHASE SYSTEM. Opitz. "Elek. Anz.," May 12.—A brief, illustrated description of a system used in Germany for supplying both light and power. The generator has two circuits, generating currents differing in phase by 90°; two ends of these circuits are combined and connected to the middle wire, while the other two ends are connected to the outside wires; there are therefore only three line wires; the motors are connected across the three wires; for the lights the primary of a transformer is connected across the outer wires only, while the secondary consists of two coils in series, their junction being connected to the neutral of a three-wire secondary system. An example showing how the cross section of the leads should be calculated is given.

COMPOUND DYNAMOS IN LIGHTING STATIONS.—Lond. "Elec. Eng.," May 20.—Replies to an inquiry why compound wound direct current dynamos are not used in electric light stations. The two replies given state that compound machines do not run well in parallel while shunt machines do, and this is a very necessary requirement.

BERLIN AND PARIS.—Lond. "Elec.," May 20.—Some brief statistics from a French journal. In Berlin there are installed about 300,000 incandescent lamps of 16 candle power, beside several thousand arc lamps; the length of mains is about 186 miles, and the power developed 28,000 horse-power; there are about 1600 motors, taking 6450 horse-power; the price for lighting is 15 cents per kw hour and for power 4 cents. In Paris there are about 418,000 lamps of 10 candle power, and 7448 arc lamps, with about 24 miles of mains, and a total power of 25,000 horse-power; there are 513 motors, taking 1940 horse-power, and the average price is 23 cents per kw hour.

PARIS.—"L'Eclairage Elec.," May 21.—Some tables and statistics for the Champs-Elysees sector.

WIMBLEDON. A. H. Preece. Lond. "Elec. Eng.," May 13.—A reprint of a paper describing this installation.

CENTRAL STATION ACCOUNTS.—Lond. "Elec.," May 20.—An analysis of the accounts of the Bradford and the Chelsea stations.

REGISTERING APPARATUS. Leroy. "L'Ind. Elec.," May 10.—An illustrated description of the Peyramale apparatus for recording any desired readings, of any kind whatsoever, on twenty-four-hour record sheets. It consists essentially of a drum revolving once in twenty-four hours by clockwork and containing properly ruled paper; it is enclosed in a locked box, which exposes only a narrow strip on the upper part of the drum on which any desired figures are then written by hand; these figures will then appear in a column corresponding to the time at which they were written; it is said to be a very useful apparatus for keeping various central station records.

DEVELOPMENT OF THE CENTRAL STATION. Insull. "West. Elec.," May 28; begun in "Elec. Eng.," May 26.—A reprint of a lecture at the Purdue University. It is almost entirely historical, describing the early development of the Edison system; in the conclusion some brief references are made to the modern Edison stations.

Wires, Wiring and Conduits.

OVERHEAD AND SUBMARINE LINES. Larose. "L'Eclairage Elec.," May 21.—An article of a mathematical nature, including several pages of tables and formulas for calculating the strains, sag, etc., in lines which are overhead or in laying or raising submarine cables; several examples illustrating the use of the tables and formulas are given. The tables and formulas are intended only for those who are familiar with the use of abstract formulas.

SNOW ON OVERHEAD WIRES.—Lond. "Elec. Eng.," May 20.—A note from a Swiss journal. Taking the specific weight of snow as 0.2, a wire 210 yards long (diameter not given) was found to have carried 120 pounds of snow, or 40 times its own weight. A recent storm broke down some posts which carried 250 wires, the storm being accompanied by a rapid fall of temperature.

Electro-Physics and Magnetism.

ELIHU THOMSON EFFECT. Weiler. "Elek. Zeit.," May 19.—A short article showing how both the attraction and the repulsion in the well known Elihu Thomson effect may be explained in the same way. As is well known, a copper ring held over the end of an alternating current magnet will be repelled and will tend to turn itself so that its plane becomes parallel to the lines of force, or that its plane cuts as few lines as possible; a copper disc, on the other hand, which is appreciably smaller in diameter than the polar surface, is under certain conditions attracted; but it will also endeavor to place itself in such a position that the minimum number of lines of force pass through it. Both phenomena are due to a phase shifting between the primary and secondary current and to the fact that iron offers some obstruction to the magnetic forces.

CONDUCTIVITY OF THIN FILMS OF SILVER. Vincent. "L'Eclairage Elec.," May 21.—An Academy paper in which he described experiments made to test the conductivity of thin films of silver on glass, made by a chemical process. The thickness was measured by transforming the silver into iodide and measuring the thickness of this. The curve of results, showing the relation between the thickness and the conductivity, is nearly a straight line, but it does not pass through the origin, indicating that the conductivity is zero, that is, the resistance infinite, for a certain minimum thickness. The films were quite continuous.

FRICTIONAL ELECTRICITY. Coehn. "Elek. Zeit.," May 19.—An abstract of the article noticed in the "Digest," May 28.—He proposes the law for non-conductors, that their order in the series, showing their relative potentials, is the same as their order according to the dielectric constant; that is, materials of high dielectric constant will be charged positively by contact with materials of lower dielectric constants; he then shows the correctness or probability of this law.

CONDUCTIVITY OF POTASSIUM PERMANGANATE SOLUTIONS. Legrande. Lond. "Elec.," May 20.—An abstract, with some of the figures, of the paper noticed in the "Digest," May 21. "L'Eclairage Elec.," May 21, reprints an Academy note in which a number of references are given to previous determinations.

DISRUPTIVE SPARK IN A DIELECTRIC LIQUID. Decombe. "L'Ind. Elec.," May 10.—An Academy note in which he described researches with the spark of an exciter in vaseline oil.

It is probable that the volatilization of the metal at the negative electrode is hindered by the presence of the liquid; the spark consists entirely of solid incandescent particles, the brightness of which follows a periodic law synchronous with that of the discharge.

DECOMPOSITION OF ELECTRIC WAVES. Berson. "L'Eclairage Elec.," May 14.—A short article describing a graphical method for decomposing any electric wave into its elementary oscillations; it is claimed to be sufficiently simple to be used in practice.

RE-ENFORCING X-RAYS. Machado. "L'Eclairage Elec.," May 21.—A brief reference to an Academy note. To increase the intensity of the rays he wraps the tubular part of the "bianode" bulb, that is the portion surrounding the tube carrying the cathode mirror, with a flexible metallic foil or with a helix of an insulated copper wire. Tubes which have become fatigued by long usage and in which the resistance has become too great, will again become useful in a few seconds with this device.

INJURIOUS EFFECT OF X-RAYS.—Lond. "Elec.," May 20.—A note stating that a committee has been appointed by the Röntgen Society to collect information on the subject of the injurious effects on the human body caused by the exposure to X-rays; a series of questions, which have been framed, are given.

TRANSFORMATION OF X-RAYS BY MATERIALS. Sagnac. "L'Eclairage Elec.," March 26.—The continuation of his long series of articles.

DEFLECTION OF CANAL RAYS. Wien. "Verh. Phys. Ges.," 17; abstracted briefly in the Lond. "Elec.," May 20.—He succeeded in deflecting canal rays, and shows that their behavior is the converse of that of cathode rays.

CATHODE RAYS. Jaumann. "Elek. Zeit.," May 19.—An abstract of a paper from a Vienna publication, in which he shows how he repeated his experiments with the interference of blue cathode light, the original experiments not having been accepted by some authorities; he showed the electrostatic deflection of cathode rays. Another experiment is described, which appears to show that cathode rays follow the negative lines of electric force.

CATHODE RAYS. Goldstein. "L'Eclairage Elec.," May 21.—An Academy paper referring to some of his earlier researches preceding similar ones by Deslandres.

CATHODE RAYS. Ebert. "Wied. Ann.," 64, p. 240; abstracted in the "Elek. Zeit.," May 19.—A paper on the behavior of cathode rays in alternating electrical fields.

CATHODE RAYS. Villard. "L'Eclairage Elec.," May 21.—A short Academy paper.

RADIATIONS IN A MAGNETIC FIELD. Cotton. "L'Eclairage Elec.," March 26.—The continuation of his long article.

ROTARY MAGNETIC POLARIZATION. Brillouin. "L'Eclairage Elec.," May 14.—A short mathematical article on this subject and the axiom of Clausius.

MAGNETIC TORSION. Moreau. "L'Eclairage Elec.," May 21.—An Academy paper on the cycles of magnetic torsion of a steel wire.

POWERFUL ELECTROMAGNET.—Lond. "Elec.," May 20.—A note on a magnet described by Sagnac before the French Physical Society for intense magnetic fields. The strongest field realized at present is that by the Du Bois annular electromagnet, weighing 270 kg, requiring 6.5 horse-power and giving a field of 380,000 C. G. S. units. Sagnac's magnet is less bulky and less costly, producing a field comparable with this, with a weight of only 100 kg and a consumption of 2 horse-power; only the pole pieces are saturated; with conical pole pieces tapering down to 1 cm in diameter a value of H = 30,000 was obtained. The real measure of the quality of the instrument is said to be the intensity of magnetization of the pole pieces necessary to produce the field obtained.

MAGNETIC NORTH POLE IN RUSSIA.—Lond. "Elec.," May 20.—A note from a recent report to the French Academy by Mascart, stating that a north pole had been found at Kotchetooka, a village in Russia. The magnetic needle assumes a vertical position at this point and the horizontal needle remains in equilibrium in all positions; the latitude is 52° N.

Electro-Chemistry and Batteries.

ELECTRODES FOR THE ELECTROLYSIS OF CHLORIDES. Becker. "L'Ind. Electrochimique," April; abstracted briefly in "L'Eclairage Elec.," May 21.—A general review and discussion of the electrodes used for the electrolysis of alkaline chlorides, pointing out their advantages and disadvantages. The carbon electrodes usually used are made of a mixture of retort carbon, graphite or of coke and a combining material rich in carbon; they are compressed under high pressure and heated to a high temperature; they resist destruction better the more compact they are, and therefore the amount of combining material should be as small as possible; it should be rich in carbon and be heated to as high a temperature as possible. Metallic oxides are also used, including peroxide of lead, plates of iron covered with magnetite or illemite; the best metallic electrodes are platinum containing 10 per cent. of iridium; those of platinum or platinized metal are not satisfactory, as the metal is rapidly destroyed. A compound of iron and silicon has been proposed for the anodes; also phosphide of chromium, pure or mixed with carbon. The cathodes are generally of retort carbon, iron or nickel; mercury, oxide of copper or copper covered with the oxide, are also used.

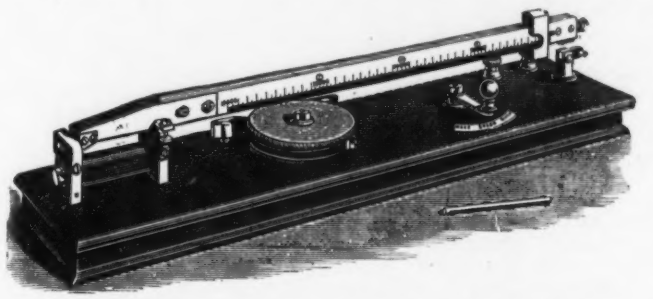
CHLORINE. Hunt and Watson. "L'Eclairage Elec.," May 21.—A brief description of their process. They use ferric chloride, and the chlorine is afterward transformed into the hypochlorite of soda or calcium. The solution is obtained from iron scrap dissolved in hydrochloric acid and heated with an excess of the metal until all the ferrous salt is transformed into ferric, and the acid neutralized; the density should be 1.4; it is then electrolyzed, the anodes being carbon; one part of the cell contains the alkaline chloride, which is separated by a diaphragm from the other solutions; the cathode is a sheet of iron on which the metal is deposited; the density of the solution should never be less than 1.2.

ACCUMULATOR CONSTRUCTION. FitzGerald. Lond. "Elec. Eng.," May 6 and 13.—In this continuation of his long serial (see "Digest"), he gives some examples of the application of the formula for the weight of the electrolyte in an accumulator, and shows how the volume and weight of the active material for a grid may be calculated.

ELECTROCHEMICAL INDUSTRIES OF EUROPE. Kershaw. "El'ty," May 25.—In this continuation of his long serial he discusses the electrolytic tin industry.

Units, Measurements and Instruments.

MAGNETIC BALANCE. Ewing. Lond. "Elec.," "Elec. Rev." and "Elec. Eng.," May 20.—A reprint of the Institution paper which was abstracted in the "Digest," last week; the accompanying illustration was not reproduced in the American reprint noticed



last week. The Lond. "Elec. Eng." gives an abstract of the discussion; the apparatus was highly praised by most of the speakers. Swinburne thought there was great possibility of error owing to the smallness of the point of contact; Ewing stated that the specimens must be free from rust or oil when tested, but it did not matter whether they were polished or not.

APPARATUS FOR DETERMINING MAGNETIC PROPERTIES OF IRON. Orlich. "Elek. Zeit.," May 12.—A reprint of a contribution from the Reichsanstalt, describing researches with the Koepsel apparatus, the original form of which was described in 1894, but has now been modified by Kath. The principle of the apparatus is the reverse of that of the D'Arsonval galvanometer; the movable coil is traversed by a constant current, while the sample of iron to be tested forms a portion of the magnetic circuit of the magnet and the deflection therefore measures the strenth of the magnetic field. In making these measurements the earth's field must be considered, and the apparatus should be so placed that the lines of force of the earth's field should cut the coil perpendicularly; before the sample is placed in the apparatus the whole instrument should be turned so that when a current is sent through the coil there will be no deflection; all apparatus of a magnetic character should be removed from the neighborhood of the instrument. The sample is inserted in the form of a rod, which forms the yoke piece of the magnetic circuit; tests were made to show the effect of using a sample which is too long and therefore projects, and the result shows that the apparatus cannot be used for determining the qualities in different parts of a long bar. In order to calibrate the instrument some iron and steel rods were tested in both this and another more reliable apparatus; they were afterwards turned into ellipsoids and tested magnetometrically; for soft iron there were practically no differences, and the result was therefore quite satisfactory; but this is limited to soft iron, as for steel the variations were greater. The measurements with this apparatus are simple and require almost no subsequent calculations.

VOLTAGE OF INDUCTION COILS. Oberbeck. "Wied. Ann.," 64, p. 193; abstracted at some length, with a number of the curves, in the "Elek. Zeit.," May 19.—In a former paper he stated that the secondary voltage of an induction coil is nearly proportional to the voltage of the primary current and that the maximum voltage of the secondary is higher the slower the vibrations of the interrupter; in the present paper he shows how the ratio of transformation changes when the primary voltage is increased or when the primary current is diminished by the insertion of a resistance. In referring to the formula of Walter for calculating the voltage, he states that so many factors must be neglected that the problem of calculating the secondary voltage must at present be still considered to be unsolved. He gives the results of his experiments to show the relation between the sparking distance and the voltage, as also the effect of the form of the electrodes and the connection of

one to earth; four cases were considered, and the curves for each are given; when both the electrodes are the same and insulated, the curves showing the relation between the sparking distance and the voltage are quite similar for balls and for points; the voltage increases rapidly at first and then slower and at medium sparking distances a further increase in the voltage is but slight, the curve being nearly horizontal; for greater distances it again increases and becomes a straight line; with dull points the sparking voltage is always smaller than with balls. In the second case both the electrodes were the same, and one of them was connected to earth; in this case the results for points and balls are quite different; moreover they are not the same when one pole is connected to earth than when the other is so connected; for small spark lengths the balls must be repolished repeatedly. Similar results are given for unlike electrodes, one a point and the other a plate, each in succession being connected to earth. He concludes that for short spark lengths the differences in the single cases are quite decided, while for large spark lengths, especially when the discharge is from a positive point, there is more uniformity. For the coil which he used a spark length of 10 cm corresponds to a voltage of about 45,000, while 20 cm corresponds to about 75,000; a voltage of 200,000 would therefore correspond to a spark length of 1 m; to produce the same length of spark between balls requires an appreciably higher voltage.

ELECTROLYTIC METER. Gibbings. Lond. "Elec." and "Elec. Eng.," May 20.—A reprint of his Institution paper describing a meter (undoubtedly the Bastian meter, a brief description of which was referred to in the "Digest," last week; the paper contains much more data than the description noticed in the "Digest" last week, beside a number of illustrations and calibration curves); the discussion is reprinted in the Lond. "Elec." and abstracted in the "Elec. Eng." The paper discusses the general advantages of such a meter, largely from the standpoint of the manager of a station; he himself believes that the meter fulfills the conditions required; the claims made for the meter are enumerated, among the chief of which are its cheapness, the absence of all mechanism, magnets, etc., the starting with infinitely small currents, the absence of repeated testing, etc.; a list of all electrolytic meters, with descriptions, is contained in the original paper, but is not reproduced in the reprint. Up to 10 amperes capacity he believes the meter can be supplied for $12.50; the greatest variation from perfect accuracy which occurred was about 2 per cent., but it is necessary to allow the liquid to settle to its normal temperature when readings are taken, as the temperature rises when the current is increased, as is shown by a curve; overloading and excess of currents do not cause trouble, as they do with other meters; at all loads the loss in the meter is over 2 volts, but this he claims is more than compensated by other advantages, such as great accuracy at light loads and the absence of shunt coil losses; he shows the important bearing this has on the whole question of meter troubles and the minimization of these is one of the chief advantages of the meter; he calls attention to the cost of calibration of meters of other kinds, while for the present one this is greatly reduced; no tests for the starting current are necessary, and an inspection once in three months instead of every month, seems to be sufficient; the cost of removing defective meters and substituting others is also greatly reduced. In the discussion Evershed stated that as a rule in electrolytic meters the electrodes are disintegrated after a year's use; one of the most serious drawbacks is the large drop of three volts across the terminals, but the consumer has nothing to do with this, as he simply uses lamps of a slightly lower voltage. Wright thought the instrument would be a material help to managers, who are not so much concerned with the question of efficiency as they are with other features; he thought the only objection to this one was the loss in the voltage, which means practically 1 per cent. of the total output of the (200-volt) station. Swan praised the meter, but thought that 5 amperes was more likely to be the practical limit of the range; the loss in voltage was a drawback when other meters were used on the same circuit, in which the drop was different; he thought the meter deserved a trial; from previous experience one would expect a tendency to the disintegration of the platinum cathode. Gibbings stated that he had tried them for only six months; about a dozen are on the circuits of the Bradford station and they are still working well, requiring refilling once in four or five months.

METER.—"L'Eclairage Elec.," May 21.—A brief description (no illustration) of the Siemens and Halske hour meter for continuous or alternating current; it is used where the current is constant.

MEASURING PHASE DIFFERENCES. Rossi. "L'Eclairage Elec.," May 21.—The conclusion of the long article of a mathematical nature noticed in the "Digest," May 21. The elements of the instrument are described and the theory discussed.

RECORDING QUANTITIES.—Lond. "Elec. Rev.," May 20.—A brief reference to Callendar's recording apparatus for recording any kind of electrical quantity directly, or other quantities indirectly; it was recently shown before the Royal Society, and has been in use for more than a year at McGill College, Montreal; a description of it was published in the Transactions of the Royal Society of Canada last year.

LEGALIZING ELECTRICAL UNITS.—"Elek. Zeit.," May 12.—Extracts from the discussion at the Reichstag concerning the bill legalizing the units in Germany. The reasons of Kohlrausch against the adoption of the watt are given; he claims that it is premature to define the watt now, as it is better to do this later than to introduce a definition now that might not be satisfactory; such a law should be limited to only that which is absolutely necessary.

WIMSHURST MACHINE.—Lond. "Elec. Rev.," May 20.—A short article pointing out that the only difference between this and the Holtz machine lies in a few insignificant details and that, therefore, Holtz deserves the credit.

Telegraphy, Telephony and Signals.

TRANSMITTING LIGHT EFFECTS OVER THE WIRES. Dussaud. "L'Ind. Elec.," May 10, and "L'Elec.," May 14.—A French Academy note describing briefly a method for transmitting light effects, such as pictures, movable or not, over wires by means of electricity; (it appears to be a mere suggestion, as no trials are referred to). There are two identical luminous beams, one at each station, and he proposes to produce the same variations of intensity in the distant one as those in the one at the transmitter. There are two identical "obturators," one at each station, with small holes at fixed distances, "but at decreasing heights," revolving synchronously; at the transmitting station selenium cells, which receive the successive elementary beams, are connected in the primary circuit of an induction coil, the secondary of which includes the line and receiver; at the receiving end there is a telephone, the diaphragm of which acts on an opaque plate having transparent lines; at the side of this plate there is another identical one, which is stationary, and on which the transparent lines correspond to the opaque parts of the first; at the receiving end the beam which traverses the two plates and the "obturator," will therefore have the same variations of intensity as that at the transmitter which passes through the "obturator" and is received by the selenium cells; the telephone diaphragm, which is controlled by the current produced in the selenium cell, will displace more or less the movable plate relatively to the fixed one, thus varying the intensity of the beam; the "obturator" determines the location of the particular part of the beam, and as all the elementary beams pass in a tenth of a second the observer sees the entire plate with the proper intensities of light at each point. (The description is not very clear.)

WIRELESS TELEGRAPHY. Lodge. Lond. "Elec. Rev.," May 20.—In a brief account of the exhibits at a recent Royal Society meeting his system is briefly described. For very long distances, however, he prefers his system of magnetic space telegraphy, which was also shown; from the very brief description shown it appears that this depends on the mutual magnetic induction of two coils placed at distant points; the discharge of a condenser around a large coil produces an alternating magnetic field which excites and induces currents in another distant condenser circuit tuned to the same frequency and causing it either to overflow into a coherer or to disturb a detector or telephone.

TELEPHONY IN SWEDEN.—"L'Elec.," May 21.—A table showing the operating costs and receipts of the telephone installations in Sweden, which are operated conjointly by companies and by the Government. The proportion of expenses to receipts since the year 1882 averages between 40 and 50 per cent., having reached as high as 65; it shows the incorrectness of the claim often made that the Government cannot operate such plants economically.

TELEPHONY IN THE UNITED KINGDOM. Raphael. Lond. "Elec.," May 13.—In this continuation of his long serial he discusses interurban telephony.

ANNUNCIATOR. Montillot. "L'Elec.," May 14.—An illustrated description of the Tournaire system for bell circuits. One of the chief advantages is that he obviates entirely the necessity of all permanent magnets, or any other part capable of becoming weak or being affected by masses of iron in the neighborhood; the dimensions are small.

TELEPHONE SYSTEMS FOR LARGE MANUFACTURING PLANTS. Clausen. "West. Elec.," May 28.—An illustrated description of a manually operated system, which is said to be very simple and in which all calling signals are transmitted by the caller direct. In connection with the development of the independent movements, he remarks that the total number of instruments is growing at the rate of at least 500 per day.

PRACTICAL FEATURES OF TELEPHONE WORK. Dobbs. "Elec. Eng.," May 26.—The eleventh installment of his long serial, which has already been referred to; manholes, the drawing-in system and electrolysis are discussed.

Miscellaneous.

COOKING APPARATUS. Haake. "Elek. Zeit.," May 12.—A long abstract of a paper read before the Electrical Society of Frankfort on the apparatus made by the Prometheus Company. Instead of using wires embedded in enamel, the enamel is painted with metallic paint such as is used for decorating porcelain and made of the noble metals. In order to enable the heating to be graduated the bands of

metal are arranged as shown in the accompanying diagram, forming three terminals; this gives four gradations, as follows: *a*, with *b* and *c* connected together; *a* and *b*; *a* and *c*; *b* and *c*; the latter is so calculated as to keep water, equal to the capacity of the vessel, at an even temperature; to obtain a better symmetry the wires *a* and *b* are crossed, bringing the terminals into a more convenient order. A band 635 mm in length, 16 mm wide and one four-thousandths mm thick, having a cross section of 0.004 sq. mm., carries a current of 3.5 amperes, but will stand an overload of 50 to 100 per cent.; a

wire of nickeline for the same service would fuse with an overload of 5 to 10 per cent.; the radiation to the surrounding air may be practically neglected and the apparatus therefore has a high efficiency, as vessels in which the water is boiling are scarcely appreciably warm on the outside; the efficiency of the large vessels is over 90 per cent. In a house in Berlin where the cooking has been done entirely by electricity for nearly a year, and where the charge is 4 cents per kw hour the cost has been found to be only 25 per cent. greater. A boiler, which is arranged to be placed into any convenient vessel, has an efficiency of 99 per cent.; the expansion coefficient of the enamel is said to be exactly the same as that of the film of metal fused into it.

TESTS OF COOKING APPARATUS.—"Elek. Zeit.," May 12. A reprint of the results of tests made by the Reichsanstalt, which were referred to in the "Digest," last week.

ELECTRICAL APPARATUS ON BOARD SHIP. Essberger. "Elek. Zeit.," May 12.—A reprint of a long illustrated paper read before the German Society of Electrical Engineers, and describing a number of forms of the Union Company's auxiliary apparatus used on board ship; it refers chiefly to the application of power for various purposes and to indicating apparatus. An indicator, showing the position of the rudder, is described and illustrated and replaces the mechanical devices which have been unsatisfactory on account of the springing of the long shafts which are required; the principle is that the rudder moves a contact arm over a resistance wire through which a current is passing, and the voltage between this arm and the neutral point of the circuit is then indicated on a voltmeter, which is calibrated to show the corresponding position of the rudder. A telegraphing or signalling apparatus based on a similar principle, and various forms of auxiliary machines for power purposes, like windlasses, cranes, capstans, etc., with their controllers, are described and illustrated. In conclusion he describes a differential machine for operating the rudder; this consists of two motors driving a so-called planet gearing, the two motors revolving continuously in opposite directions; when they have the same speed the wheel of the planet system is stationary; to move the rudder the fields of the motors are varied so that they have relatively different speeds.

EXPLOSION OF FIRE DAMP. Couriot and Meunier. "L'Ind. Elec.," May 10, and "L'Elec.," May 14.—A reprint of an Academy paper discussing the effect of self-induction on the explosion of mixtures of fire damp and air by the electric spark. In previous papers (see "Digest," April 25 and May 21,) they showed that the explosion was caused by the spark at the breaking of the circuit; it was found that an increase of the induction will effect the production of the explosion, and in the present paper they describe experiments made to determine this effect. The results are not in such a form that they can be abstracted here.

CARBONS. Jehl. Lond. "Elec.," April 15 and May 6.—In this continuation of his long serial he gives illustrated descriptions of the machinery used in their manufacture.

LIGHTNING RODS.—"L'Elec.," May 21.—A translation of the rules and regulations concerning lightning rods in Berlin, which were noticed in the "Digest," some time ago.

TECHNICAL EDUCATION IN LONDON.—Lond. "Elec.," May 20.—An editorial, chiefly of local interest.

PRIZES.—"L'Ind. Elec.," May 10.—A statement of the conditions for the prizes offered for the year 1899 by the Société d'Encouragement pour l'Industrie Nationale. One is a prize of $600 for a method of manufacturing permanent magnets; another of $300, for electric incandescent lamps of 2 candle power maximum and running with a tenth of an ampere at 100 volts; another of $300, for certain kinds of electrical apparatus used in commerce.

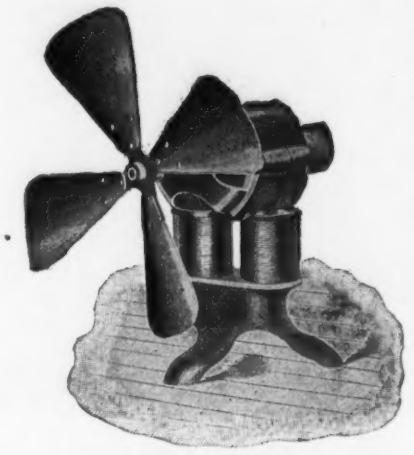
OZONE PRODUCTION.—"West. Elec.," May 28.—An illustrated description of the new form of the Andreoli apparatus, which was noticed in the "Digest," last week; there are more and better illustrations in this description than in the one noticed before.

STERILIZATION OF WATER BY OZONE. "West. Elec.," May 28.—An abstract, with the illustration, of the article describing the Tindal system used at Brussels, which was noticed in the "Digest," January 8.

EDUCATIONAL. Smith. "West. Elec.," May 28.—A short article on the development of a school of electrical engineering, with special reference to the Worcester Polytechnic Institute.

A Hydro-Electric Fan Motor Outfit.

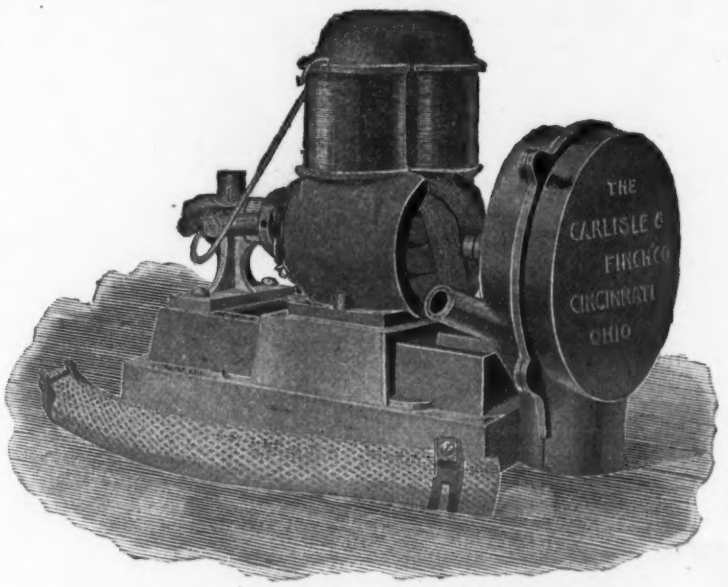
The electric fan motor and combined water motor and dynamo illustrated herewith is the latest production in this line of apparatus, and is being placed upon the market by the Carlisle & Finch Company, Cincinnati, Ohio. The water motor may be attached to any house faucet, a water pressure of 40 pounds being sufficient to operate it. The dynamo which is direct connected to the water motor is said to be as well designed and constructed as the larger



FAN MOTOR.

machines. It is provided with self-oiling bearings, carbon brushes, steel field magnet, toothed, laminated armature, etc. The motor drives a 9-inch fan at 1800 revolutions or more, according to the pressure of the water. It is said to be strong and well made.

With this self-contained apparatus anyone can keep delightfully cool in the hottest of weather. The fan may be easily moved from one room to another and placed in any convenient position. Insulated wire is furnished with each outfit to connect the fan motor with the generator. The dynamo may also be



DYNAMO DRIVEN BY WATER MOTOR.

used to charge storage batteries, run motors, light incandescent lamps, etc. Its output on 40 pounds water pressure is one ampere at twenty volts. High water pressure, it is stated, gives a correspondingly increased output. The apparatus is so simple that it will run for days without any other attention than turning on or off the water. The combination has several features that recommend it, and no doubt it will meet with a large demand.

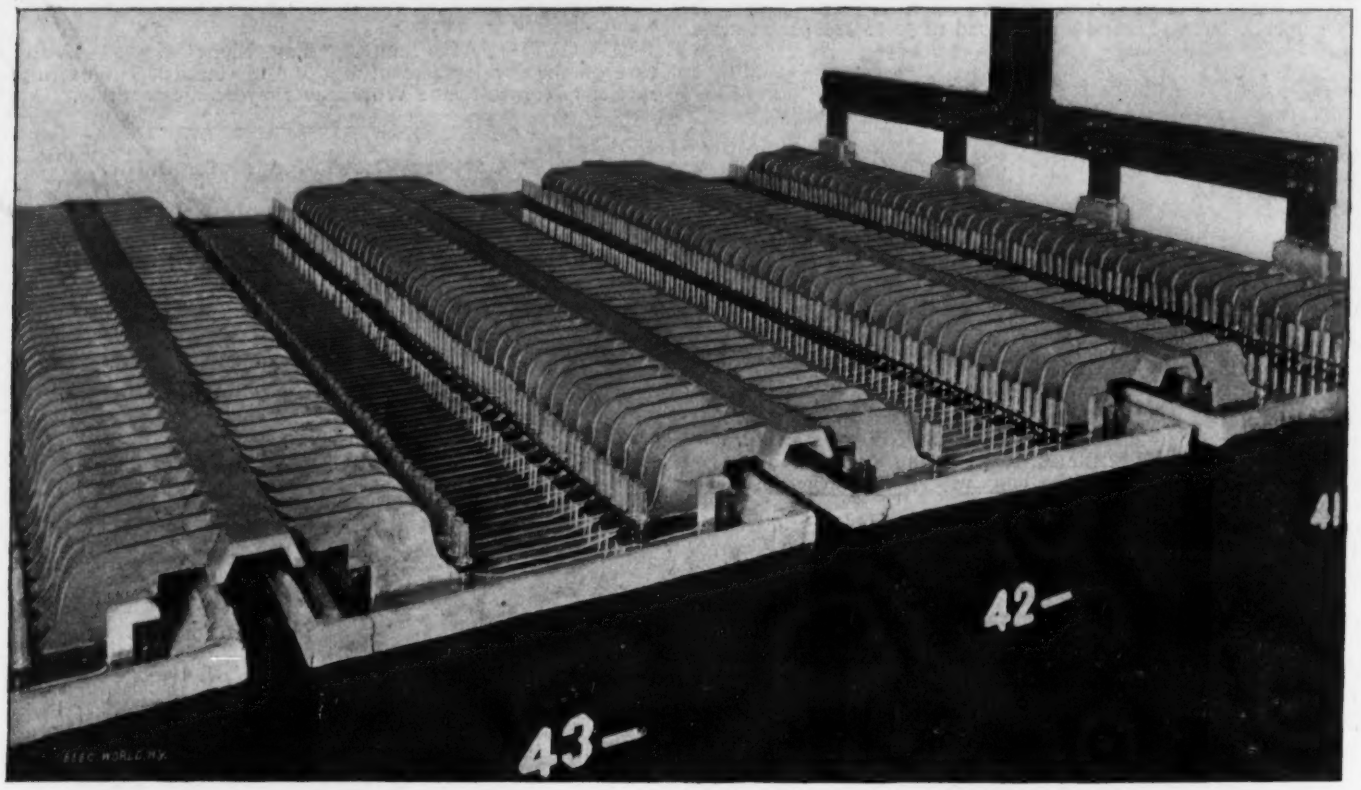
The Chicago Edison Company's Storage Battery.

The largest storage battery in the world has just been installed by the Electric Storage Battery Company, of Philadelphia, for the Chicago Edison Company. The latter company has been operating a regulation three-wire, low-voltage, direct-current system, with several generating stations, of which the high cost of generation and distribution can be brought down by the application of recent developments in the art. The company has already installed a three-phase high tension alternating transmission line for throwing the load of one of its stations on to the large Harrison Street station on the water front, and now, to bring the system still more in conformity with the latest improvements, it has installed this mammoth storage battery.

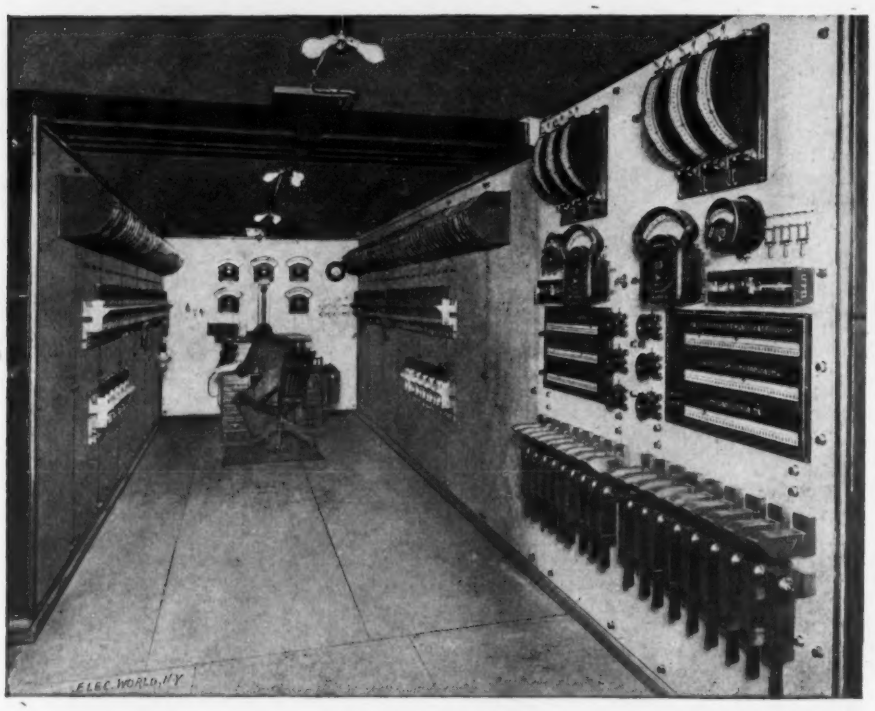
The site of the original plant at 139 Adams Street is now used by the company for an office building and a centre of distribution, current being brought to it from the Harrison Street station over a trunk line feeder 3500 feet long, and then distributed on feeders varying from 800 to 3000 feet in length. The daily ampere hour load over this trunk line ran up during the winter to some 44,000 ampere hours, and at the present rate of growth will come up to 55,000 ampere hours during next winter. The peak of the load rises in winter time to about 12,000 amperes. In order to smooth out this daily load curve on the boilers, engines, dynamos and feeders and to avoid the expense of increasing the size of all parts of the equipment to carry the peak of the load curve, this storage battery has been installed in the basement of the office building.

The battery is placed on a grillage of 4-inch I beams laid in concrete and over which are a few courses of tarred felt, the floor being of vitrified tile laid in a mixture of asphalt and cold tar. The lower ends of the columns are encased in lead, above which they are treated with a galvanic varnish, over which they are enclosed in a wire netting covered with an alkaline cement plaster and a coating of anti-acid paint. Two ducts are run the whole length of the room on opposite sides, one for supplying and the other for exhausting the air.

The battery has a capacity of 22,400 ampere hours at an eight-hour rate, and will be able to discharge 11,000 amperes for about one and a quarter hours. It consists of 166 cells (60 of which are end cells), eighty-three on each side of the three-wire system. This large number of end cells is required to meet the demand for a wide variation of pressure. The battery is called upon to deliver 140 volts on each side at the end of discharge and in case of emergency to deliver current at a maximum of 120 volts on each side when fully charged. Each cell contains eighty-seven plates (known as type "H" in the nomenclature of the Electric Storage Battery Company), the dimensions of which are



View of Cells, Showing Method of Connecting Them Together.



Feeder Switchboards and Storage Battery Regulating Switchboard.

Some of the End Cells.

15½ inches x 32 inches. The plates are of the standard Manchester positive and chloride negative. Each tank is 21½ inches wide by 79¾ long by 43⅜ inches high, and weighs 6200 pounds. The tanks are constructed of 2-inch ash, lined with 5-pound sheet lead. They are each supported on ten double petticoat insulators, resting on tiles laid on the acid-proof floor. The total weight of the whole battery, exclusive of the conductors, is 1,029,200 pounds.

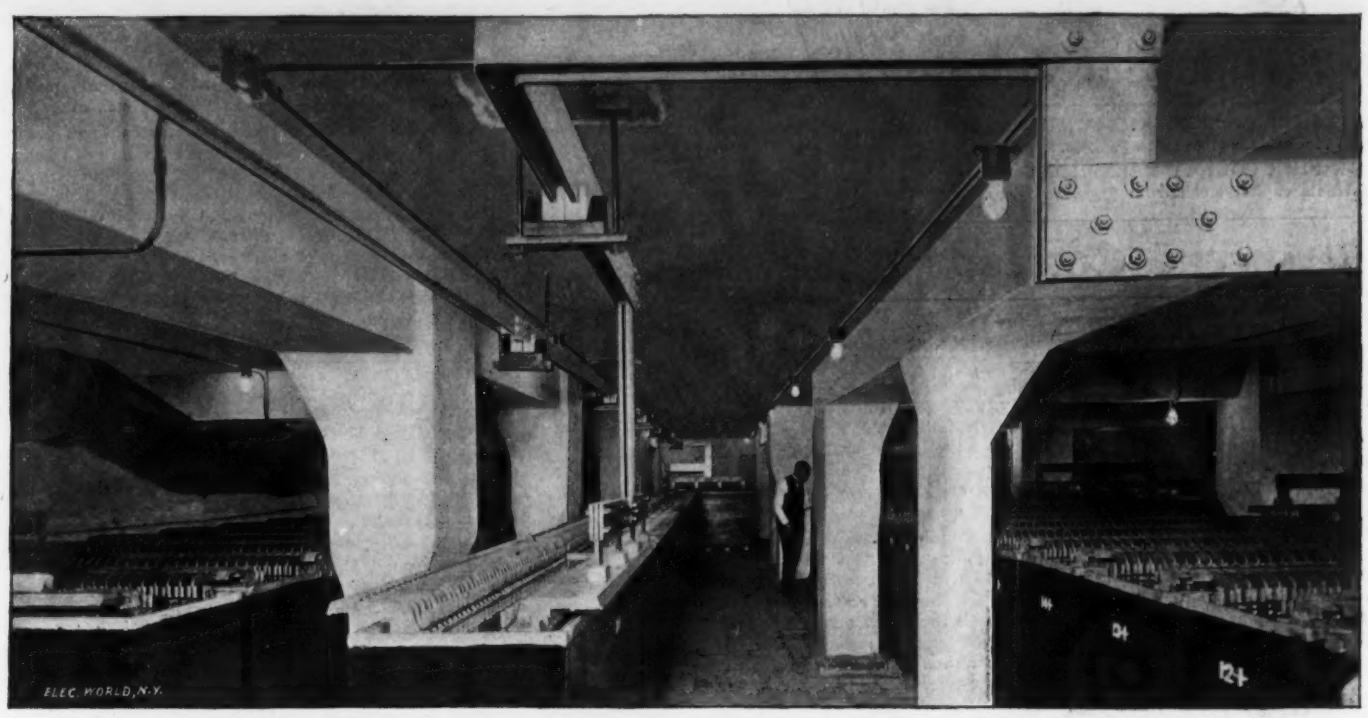
The end cells are connected to the end cell switches by lead covered copper bars 6 inches by one-half inch, supported by insulators resting on iron girders strung between the columns of the building. The main connection of the battery consists of two copper conductors giving a sectional area of 6 square inches. All copper is coated with lead to render it impervious to the corrosive action of the acid gases.

There are six end-cell switches, three on each side of the system. These switches have thirty points and are capable of carrying 2750 amperes each. The connection between the thirty contacts and the bus bar of the switch is made by a laminated copper brush traveling on a screw operated by a ½-hp series motor. These motors are put into operation by push buttons on the controlling switchboard, and are stopped automatically when the brush reaches the midpoint on the contact block by an automatic device, which breaks the motor circuit and short circuits the armature. The switches are also provided with a hand wheel for hand operation if desired. Gear wheels are provided so that the three switches can be geared togther and operated as one, thus giving a capacity of 8250 amperes on each side of the system.

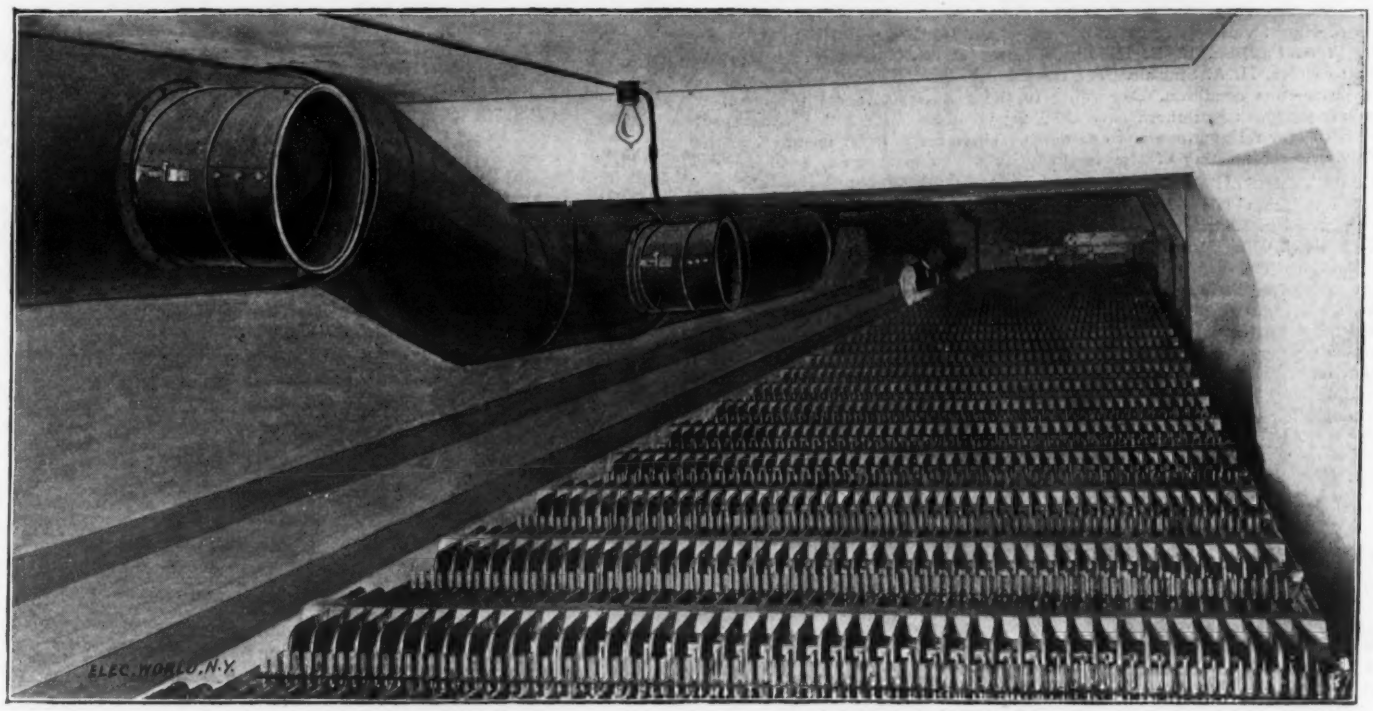
The controlling board is connected to the bus bars of the end cell switches by twelve cables of 1,500,000 circular mils each. On the controlling board there are three single pole switches for each end cell switch, enabling it to be connected to either the main, auxiliary or charging buses. Each end cell switch has an indicator on the controlling panel, operated mechanically by light shafting and gearing, which shows the operator the exact position of the traveling brush on the end cell switch at all times. On each panel of the board there is a thirty-point voltmeter switch connected to a low reading voltmeter, which enables the operator to take the voltage of each end cell.

One of the important features in connection with the battery installation is the method of charging without the use of boosters, which are ordinarily employed in most battery installation. Charging current is supplied by a pair of 200-kw machines in the Harrison Street station, working at about 180 volts, connected to the battery by a portion of the trunk line mentioned above. The field rheostat switches of the dynamos are operated by small pilot motors, which are controlled by the operator in the battery station by circuits run in special small lead covered cables. The generators which are used for charging are not specially made for the purpose, but are standard machines used at other periods of the day to feed into the main bus bar of the station, thus saving an investment of about $15,000 in boosters, as well as providing a system of charging more economical than any in which boosters are employed.

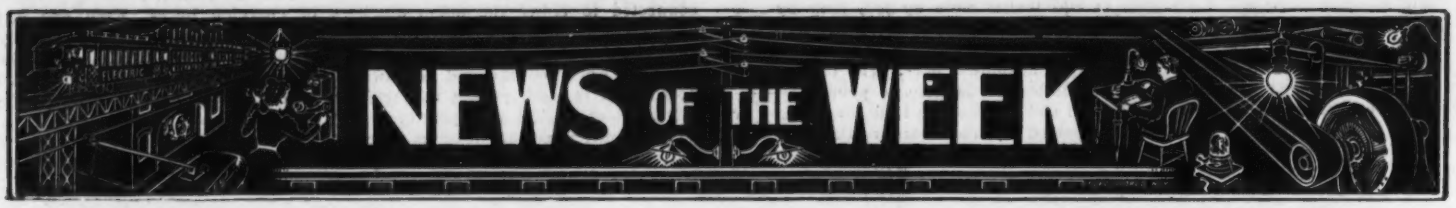
In summer the battery will be kept floating on the circuit during the day, keeping the engines working at the most economical point. During the winter its chief duty will be to take care of the peak of the load, for which purpose it was primarily purchased. By maintaining the battery on the circuit continuously the care required in the regulation of pressure at the generating station is very much lessened.



REAR PORTION OF THE BATTERY ROOM, SHOWING OVERHEAD LEADS.



REAR BATTERY ROOM, SHOWING VENTILATING DUCTS.



Financial Intelligence.

THE SHELBY ELECTRIC COMPANY, Shelby, Ohio, has increased its capital stock from $100,000 to $250,000.

THE PIKE COUNTY TELEPHONE COMPANY, Pittsfield, Ill., has increased its capital stock from $3,500 to $5,000.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, June 3, 1898.

HEAVY TROLLEY TRAFFIC IN BROOKLYN.—On Monday, May 30, the various street railway lines in Brooklyn did the largest business on record. It is estimated that over 1,000,000 passengers were carried. The receipts on the Brooklyn Heights system amounted to $27,140, and they were correspondingly large on the Nassau and other roads.

BIDS FOR LIGHTING the streets of the Borough of Brooklyn were opened by the Commissioner of Public Buildings, Lighting and Supplies on May 31. The lowest bidder was the Kings County Electric & Illuminating Company. Five bids were submitted by this concern, one for the entire borough and four others for the sections. The prices were all the same, namely, 30 cents a night for each 1200-cp arc lamp; 35 cents a night for each 2000-cp arc lamp, and 1¼ cents per ampere hour for incandescent lights. Other bidders were the Edison Electric Illuminating Company, the Citizens' Illuminating Company and the Mutual Electric Light Company.

PROMINENT ENGINEERS SEEKING COMMISSIONS.—Among the applications for officers' commissions in the first regiment of the volunteer engineer corps, which were considered by the examining board in this city on May 31, were those of William Barclay Parsons, chief engineer of the Rapid Transit Board, and Dr. Louis Duncan, of Johns Hopkins University, Baltimore. Col. Eugene Griffin is a member of the examining board. The first regiment, which Colonel Griffin is to command, is to have fifty-three officers and 1100 enlisted men, including military, civil, electrical and mechanical engineers, blacksmiths, plumbers, carpenters, photographers, etc.

THE NEW YORK ELECTRICAL SOCIETY'S NEW OFFICERS.—The annual meeting of the New York Electrical Society was held at Madison Square Garden on Thursday, May 26. The following officers were elected: President, Gano S. Dunn; vice-presidents, Willard S. Case, H. B. Coho, Dr. C. A. Doremus, F. A. Pattison, E. E. Higgins, Charles Blizard; secretary, George H. Guy; treasurer, H. A. Sinclair. The treasurer's report shows the society to be in a prosperous condition. According to the secretary's report the membership last year was 397; there have been 215 members elected this year; there have been four resignations and one death. There are now 607 members in the society. At the meeting of May 26 thirty-seven new members were elected.

AN INTERESTING AND NOVEL CEREMONY took place at the Electrical Exhibition last Wednesday evening. Notoriety-seeking couples have been married in balloons in mid-air and on Pike's Peak, but Mr. C. S. Merten and Jennie S. Gilmour, of New York City, enjoy the distinction of having been launched on the matrimonial sea largely by the aid of electricity. The event took place in the Moore chapel, which was illuminated by vacuum tube light, the bride and groom having been conducted to Madison Square Garden in electrical carriages. The wedding marches were played upon the electrically operated pipe organ in the chapel, and hymns were reproduced on phonographs. The transformation from the two-phase state of existence to single phase was accomplished by means of an old fashioned converter, i. e., a minister. May the couple never get out of phase!

SOUTHERN NOTES.

WASHINGTON, D. C., June 1, 1898.

THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY has opened offices in this city in the building formerly occupied by the Western Union Telegraph Company.

THE MOTIVE POWER on the Seventh Street car line was on May 25 changed from cable to electric. The work of introducing the electric system was carried on without the slightest interference with traffic, and the line is operating successfully under the new conditions.

THE BRIGHTWOOD ELECTRIC RAILWAY COMPANY desires to introduce the underground conduit system on its line, and the District Committee of the House of Representatives has favorably reported on a bill authorizing the company to carry out its plans within a year.

SECRETARY OF WAR ALGER has made various recommendations for appropriations to carry on the campaign against Cuba, Porto Rico and the Philippines. Among the appropriations asked for is $195,000 for the establishment and maintenance of special electrical communication in connection with the army at the localities above mentioned. This amount includes the purchase, equipment and repair of field electrical telegraph, signal equipment, telephone apparatus, electrical installations and maintenance, military posts, maintenance and repair of military telegraph lines and cables, etc., etc.

THE GREAT FALLS OF THE POTOMAC.—The House of Representatives District Committee has reported favorably on the Senate bill providing for the acquisition by the Government of the water rights and privileges of the Great Falls of the Potomac, about 16 miles from the city of Washington. This matter has been exhaustively discussed for many years. The city of Washington now gets its light through the Great Falls Power Company, and if Congress finally passes the bill providing for the acquisition of the power rights of the falls it will be a severe blow to the company. The chief reason for the public ownership of the lighting plant is the large number of public buildings and parks in this city, the lighting of which costs the Government a very large sum every year.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., June 1, 1898.

THE WESTERN ELECTRIC COMPANY has issued an invitation to the members of the National Electric Light Association, who will meet in convention in this city on June 7, 8 and 9, to visit its shops any time during the convention. The company's shops are at 242 South Jefferson Street, and the association's badge or a copy of the invitation will assure the wearer or holder facilities to see all or any portion of the shops.

THE ELECTRIC STORAGE BATTERY COMPANY, through the courtesy of the Chicago Edison Company, extends an invitation to the members of the Electric Light Association to inspect the large storage battery installed for that company in the Edison Building, 139 Adams Street. A representative of the Electric Storage Battery Company will be present in the battery room in the basement of the Edison Building, who will take pleasure in explaining the operation of the battery to visitors. Presentation of an invitation, or the association badge, at the Edison Building will assure the bearer of an introduction to the battery room.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., May 28, 1898.

ELECTRIC STREET SPRINKLING has been introduced in Portland, Ore. An ordinance was recently passed by the Council authorizing the awarding of a contract for that purpose.

THE BILL providing for a telephone system for the Table Rock lighthouse at Salmon Creek, Humboldt County, Cal., has been favorably reported from the commerce committee. The cost of the line must not exceed $5000.

THE EAST SIDE RAILWAY COMPANY, Portland, Ore., is now controlled by Morris & Whitehead, the bankers, who bought the bonds of the company from the German Savings & Loan Company, of San Francisco. The mortgage will be foreclosed very soon, the road reorganized and extensions made.

THE MUTUAL ELECTRIC LIGHT COMPANY, San Francisco, of which P. B. Cornwall is president, recently brought suit against the Board of Supervisors to compel them to permit the company to erect poles where required in case it should put in the lowest bid for lighting the streets and public buildings. Because the plaintiff had no speedy remedy at law they asked for a mandate of court to compel the Supervisors to accord the Mutual Company equal advantages with the San Francisco Gas & Electric Company.

THE SUNSET TELEPHONE & TELEGRAPH COMPANY has perfected its plans for improvements, costing $80,000, in Seattle, Wash., and stands ready to begin laying underground mains as soon as permission is granted by the city. The conduits contemplated can be completed in three months, and the entire new system to be in operation in six months. A two-story telephone building, 40 by 110 feet, will be erected. The new plans are arranged to accommodate 7500 subscribers. Mr. Louis Glass, assistant general manager, recently visited Seattle.

FRENCH NOTES.

(From Our Own Correspondent.)

PARIS, May 18 1898.

AN ELECTRIC TRACTION MACHINE FOR BOATS.—Instead of placing the propelling mechanism for auto-cars directly on the carriage, many inventors have striven to put the machinery on a separate vehicle to be used to haul the carriage proper; that is, to invent a traction engine which could be used at will in place of the classic means now used to drag carriages. Mr. Bowick has come forward with a similar idea for boats. His apparatus may be used to metamorphose any kind of boat into an electric boat on the spot. All that is necessary is to hitch the working part on in front and to place in the boat a storage battery to furnish the necessary energy to the motor on the tractor. The motor is mounted on a float hitched to the boat, and drives a screw. In this way the vibration, which at high speed becomes very fa-

tiguing, need no longer be felt by the passengers in the boat. The machinery is managed very simply by the person sitting in the bow, who holds a pair of reins, and the stronger the pull the greater will be the speed of the motor, the cords being connected with a lever which throws on more cells. The arrangement maintains an average speed of 8 to 9 miles per hour.

ELECTRICITY IN THE SEWERS OF PARIS.—M. Legoüez, civil engineer for the Government and in charge of the sewer department, has gotton up, with the assistance of M. Levêgue, a system of electrical travel in the great sewers of Paris. Besides greatly facilitating the maintenance of the sewers, it is also a great convenience in taking about the visitors, who become very numerous during the season. The equipment is as follows: Every train of six boats is furnished with an electric towing machine at each end, acting on the magnetic principle devised by M. de Boret. The towing is done by means of a chain sunk in the receiving sewer of Asnières, between the Madeleine and the Place de la Concorde. The machine facing toward the Place de la Concorde, called the leader, is of greater power than the follower, and is used in going up stream. The motor has a speed of 580 r. p. m. With the larger machine working the effect on the chain required to haul a complete train, with load, at the rate of 2280 metres (1½ miles) per hour is 700 kilograms (1500 lbs.). A current of sixty amperes at sixty-five volts or about 5¼ horse-power, suffices for the service between the Châtelet and the Madeleine. Each train holds 100 persons, which gives a capacity of 600 visitors daily.

THE DUODECAPLEX OF MERCADIER.—Experiments are at present being conducted on the Paris-Bordeaux line with some very interesting machines, which the inventor, M. Mercadier, has been working on for many years. With these instruments, called duodecaplex, twelve Morse transmitters can work simultaneously on a single wire, each sending its signals to the proper receiver at the end of the line. This result is brought about by the use of alternating or, at any rate, interrupted currents. Each transmitter receives its current through a tuning fork having a special note, its vibrations being electrically maintained. These vibrations furnish a current of the proper period to cause resonance at each application in the proper receiving circuit, which has its self-induction and capacity adjusted for this result. This receiver is a telephone, a monotelephone, as it is called by M. Mercadier, so constructed and arranged that the acoustic resonance qualities also help to damp out from the signals received everything not intended for it. These signals are read in the ordinary way by ear, aided by rubber tubes like those used on phonographs. The sifting out of the signals, it seems, is very perfect, each receiver giving no evidence of those signals not intended for it except a slight murmuring very indefinite and not at all bothersome.

THE PARIS METROPOLITAN RAILWAY.—The law declaring the Metropolitan Railway a public necessity has at last become an official fact. It reads as follows: 1. The building of an electrically operated railway in Paris is, on local grounds, hereby declared to be a public necessity. The road will embrace the following lines: (1) From the Porte de Vincennes to the Porte Dauphine; (2) a belt line on the older exterior boulevards; (3) from Porte Maillot to Menilmontant; (4) from the Porte Clignancourt to Porte d'Orleans; (5) from the Boulevard de Strasbourg to the Austerlitz Bridge; (6) from Vincennes to the Porte d'Italie; (7) connecting lines between these various routes. The maximum time allowed for the entire completion of the work is fifteen years. 2. Rolling stock must not exceed 2.40 metres (7 feet 10½ inches) in width, including all steps and running boards. The gauge of the track will be 1.44 metres (4 feet 8½ inches). The construction of the Metropolitan Railway should make it possible, technically speaking, for the great lines to enter Paris. The Metropolitan Railway tunnel under the Seine is to be down stream from the dam at the Mint, and beyond the foundation of the bridge which has been planned in connection with the extension of the Rue de Louvre. 3. The length of trains will be limited to 72 metres (236 feet), and the speed must not exceed 36 kilometres (22 miles) per hour.

RECEIVER FOR HERTZ WIRELESS TELEGRAPHY.—On May 2 M. E. Ducretet read a paper before the Paris Academy of Sciences on an instrument for receiving telegraphic signals without wires. It is well to notice here that M. Ducretet, rightly or wrongly, entirely passing over Marconi's discovery, gives the credit of it to various other scientists, chief among whom he mentions Branly. According to him this invention should belong to all, and hence to himself. He calls it Hertz telegraphy also, because Hertz waves are the means of communication. However this may be, the receiving instrument, which he brought out at the academy, "involves working parts," as he puts it, "which are of my own invention." It is composed of a coherer furnished with an automatic tapper or vibrator; this type has no glass tube and no inside cylinder. A sensitive relay is inserted in the circuit with the coherer, and has polarized armatures mounted on a horizontal axis and balanced. This relay works a mechanical recorder for Morse signals ;and M. Ducretet calls especial attention to the fact that his arrangement is automatic; he is able to omit the usual telegraphic attendant to start and stop the machine on the beginning and cessation of the signals. With M. Ducretet's system the Morse recorder starts the paper strip entirely of its own accord upon the arrival of the first signal, and it stops itself when the waves cease to come. A blank space separates each message or each record of a wave. For ordinary telegraphy and more especially for Hertz telegraphy, the importance of this device will at once be apparent to investigators.

STANDARDIZING BUREAU FOR ELECTRIC LIGHT PLANTS AT MULHOUSE.—This bureau has recently been established by the Alsace Society of Proprietors of Steam Machinery, and is under the direction of M. Pierron. The laboratory contains instruments for the measuring of direct and alternating currents, resistance, insulation, etc., and also instruments of precision used for standardizing purposes. The association has one of Messrs. Chauvin & Arnoux's calibrating sets, which is arranged to measure sets of from 1 to 2000 amperes on a single millivoltmeter, by the use of standard resistances. The voltmeter which goes with the set is provided with resistance coils for the measurement of pressures of 3, 30, 150, 200 and 600 volts. The voltmeters made by Chauvin are based on the principle of the siphon recorder, which makes them sufficiently dead beat. These instruments will undoubtedly find a use in factories. For checking these instruments or for taking their place the association possesses two other sets of apparatus, one made by Weston, at Newark, N. J. and the other by Siemens. The machines used to furnish current for calibration of instruments were built by the Electric Lighting Company, and have been very satisfactory. The alternator, which is designed to furnish single-phase, two-phase and three-phase currents, is used chiefly for calibrating commercial voltmeters for a given frequency. The accumulators were built at the laboratory. So far there are six batteries of eighty elements; these batteries are charged at the pressure of the city current (230 volts). There are to be in all fourteen sets of 80 elements, furnishing, when they are all in series, a voltage of about 2200 volts. The distribution switchboards, the cables and connections used for testing purposes, and the connecting of the laboratory with the supply mains of the city, were all done by the employees of the Electric Light Company. In short, this installation has had great success, and is well up to the standard set in other countries. The association is now in a position to undertake the standardizing for all the plants in that region, and will in this way be of great service to Alsatian electrical industries.

General News.

THE TELEGRAPH AND TELEPHONE.

BUCYRUS, OHIO.—The Bucyrus Telephone Company began business on June 1 with 200 telephone subscribers.

JANESVILLE, WIS.—The Janesville Telephone Company has made application to the City Council for a franchise.

EMPORIA, KAN.—Edwin A. Knapp, of St. Louis, has been granted a franchise to establish a telephone exchange in this place.

DENVER, COL.—The Colorado Telephone Company is building a line to La Porte and Livermore, and expects to have it in operation by July 15.

ALPENA, MICH.—The Mutual Telephone Company is preparing to construct lines along the Alpena & Northern Railway, and possibly to Long Rapids and Hillman.

MANCHESTER, OHIO.—Mr. M. F. Crisman, of this place, has been granted permission by the County Commissioners to construct a telephone line from Manchester to Rome.

HARRISBURG, PA.—A charter has been granted to the Columbia & Montour Telephone Company, which is composed of capitalists of Shamokin, Sunbury, Danville and Bloomsburg. The capital stock of the company is $50,000.

PITTSBURG, PA.—The Maryland, Pennsylvania & West Virginia Telephone & Telegraph Company is arranging to extend its system. A fifteen-year contract with the Union Telephone Construction Company has been ratified. The capital stock of the company will be increased.

FALL RIVER, MASS.—The American Telegraph & Telephone Company has obtained an injunction against the Fall River & Newport Street Railway Company, restraining the latter from interfering with its telegraph and telephone poles and wires in the towns of Tiverton and Portsmouth.

MUNCIE, IND.—The Muncie Telephone Company is preparing to build a number of toll lines out of Muncie, connecting a number of cities in this State. Among the places to which the lines will be extended are Anderson, Indianapolis, Fort Wayne, Hartford City, Elwood and New Albany.

MANKATO, MINN.—The capital stock of the Mankato Citizens' Telephone Company ($10,000) has been subscribed, and 175 instruments have been taken by citizens on five-year contracts at $1.25 per month for residences and $2 per month for business houses. The company has asked for a franchise. It is expected to have the system in operation by July 1.

BUFFALO, N. Y.—The Western New York Telephone Company has filed with the Secretary of State a certificate of extension of its territory to include all of New York State except New York County and Long Island, and all of Pennsylvania and Delaware. The capital of the enlarged company is $500,000, and the directors are Edward Michael, Henry Korn, Alonzo R. James, Tracy C. Becker, L. Franklin, Messer, Isadore Michael, William S. Grattan, of Buffalo; Richard F. Rankine and Spencer J. Lawrence, Niagara Falls.

TERRE HAUTE, IND.—The Citizens' Telephone Company expects to have by July 1 connections between Terre Haute and over 165 towns in this section. This company was lately organized, with a capital stock of $25,000. It proposes to push the long distance lines first, so that when the city telephones are placed the subscribers will immediately have the benefit of good long distance service. It is stated that the present telephone rates will be cut. The stockholders of the company are Terre Haute merchants and citizens. It is expected that the board of directors will take steps to increase the capital stock to $75,000, thus insuring a modern and first-class equipment and service.

MINNEAPOLIS, MINN.—Judge Anderson has decided that Lake Street, between Third Avenue, South, and Calhoun Boulevard, in this city, is a post road, thus upholding the right of the Northwestern Telephone Company to erect poles and string wires along that thoroughfare. The decision of the court was based upon a decision made by the United States Supreme Court and other United States courts, holding that any State legislation that excludes any telegraph company—and in the eyes of the law a telephone company is the same as a telegraph company—that has accepted the act of Congress, from going upon such post roads, is void. The court decides that the Northwestern Telephone Company has the right to occupy the street with its lines, subject to reasonable restrictions.

ELECTRIC LIGHT AND POWER.

TRENTON, N. J.—The village of Elmer is considering the erection of an electric light plant.

ELMA, IA.—Electric light or no electric light is the question to be decided by the citizens of this place at a special election June 10.

SCRANTON, PA.—Another electric motor is being placed in the Woodward colliery, near Kensington, enlarging the electric hauling plant.

NASHVILLE, TENN.—It is stated that the Bristol Gas & Electric Company and the Consumers' Electric Company, of Bristol, will be consolidated.

POULTNEY, VT.—Wires for the electric lights will be strung from Granville to Middle Granville this month, and the latter place will be lighted by the middle of June.

NEW HAVEN, CONN.—The Housatonic electric power scheme has been postponed because of failure to secure contracts for power in Waterbury, one of the cities the company expected to supply.

LANCASTER, PA.—Jacob Stumpf has been awarded the contract for remodelling and enlarging the substation for the Lancaster Electric Light, Heat & Power Company. Work will begin at once.

SYRACUSE, N. Y.—The Common Council by a unanimous vote has granted the Electric Light & Power Company a subway franchise. All the company's wires within the half-mile circle will be placed underground.

FLUSHING, N. Y.—The New York & Queens Light & Power Company has received a contract to furnish electric lighting for Point View, College Point. One hundred and fifty arc and incandescent lights will be used.

SYRACUSE, N. Y.—The Village Trustees of Homer have annulled the contract for lighting the streets with electricity, which was let to George A. Brockway. This action is the result of the breaking down of a dynamo at the power house.

NEWTON, N. J.—The contract to light the 107 arc lights in Port Jervis has been awarded to the Deer Park Electric Light Company for three years at $74.77 for each light annually. Lights are to be 1200 candle power, to burn all night and every night.

PHILADELPHIA, PA.—Lehighton's Town Council has awarded the contract for the erection of a new electric light plant to the Fort Wayne Electric Corporation, for $18,000. The plant is to be completed thirty days after the contract has been signed.

WILLIAMSPORT, PA.—A large number of men are employed in the construction of the power house for the Jersey Shore Electric Light Company. The Keeler Company, of this city, has the engine and boilers on the ground and is placing them in position.

LEBANON, OHIO.—There will be a special election on June 6 to decide whether the Council be authorized or not to issue bonds of the village in the sum of $20,000 to purchase an electric light plant. The proposition to carry must receive two-thirds of the votes.

BROOKLYN, N. Y.—The Patchogue Electric Light Company will shortly remove to its new location on the Patchogue River, where a brick power house will be erected. An effort will be made to consolidate the electric company with the proposed gas company.

MITCHELL, S. DAK.—Owing to the burning of the electric light plant the town is in darkness, and will remain so until the works are rebuilt. Work will begin immediately, and will require probably six weeks' time. The boilers were injured but little and the engine can be utilized again.

PHILADELPHIA, PA.—It is reported that the proposition to take the Northern Electric Light Company, of this city, into the Pennsylvania Manufacturing Light & Power Company has been accepted by the controlling interests on both sides, and the transaction has become practically an accomplished fact.

WILMINGTON, DEL.—The merging of the Wilmington City Electric Company and the Wilmington Light, Heat & Power Company, which has been talked of for two months, is an accomplished fact. The consideration under which the charter passes into the hands of the first-named company is reported to be $10,000.

HARTFORD, CONN.—It is understood that the scheme for furnishing electric power to Waterbury corporations from the Housatonic River has been abandoned for the present. It is possible that the granting of a five-year contract for electric lighting to the Waterbury Traction Company by the city has something to do with the present apparent apathy.

NIAGARA FALLS, N. Y.—Another plant that is contemplating an enlargement of its capacity is the Mathieson Alkali Works. This company now uses 2000 electrical horse-power, and it is to add to its facilities so that it will take 6000 horse-power from the output of the Niagara Falls Power Company. This will call for the employment of many more hands. Work on the addition is expected to commence within two months.

BOSTON, MASS.—The Massachusetts Senate has rejected by a vote of 18 to 13 a bill to authorize electric light companies to sell gas. Several speakers during the course of the debate declared that the bill, now a law, permitting gas companies to sell electricity, ought never to have passed. Other speakers thought that the Massachusetts Pipe Line Company and the New England Gas & Coke Company might as well be brought into such combinations.

The Electric Railway.

NORRISTOWN, PA.—A large force of men has been put to work on the Ringing Rocks Electric Railroad preparatory to starting the line.

LOCKPORT, N. Y.—The Lockport-Buffalo Electric Railroad will be extended to Olcott before the summer passes. The right of way has been secured and many obstacles removed.

CHICAGO, ILL.—The North Shore Interurban Railroad Company has changed its name to the Chicago & Milwaukee Electric Railway Company, and increased its capital stock from $340,000 to $1,000,000.

BRATTLEBORO, VT.—The Mad River Valley Electric Railroad has been formed. This road will open up a large lumbering and farming country, and there are valuable soapstone quarries along the route.

NEW YORK CITY.—The Red Bank and Long Branch, N. J., trolley road has passed into a receiver's hands. The road has been losing money since its inception. The receiver, it is stated, will wind up its affairs.

DOYLESTOWN, PA.—Upon the opening of the trolley road from Doylestown to Willow Grove the through fare to Philadelphia will be only 25 cents, just one-third of the fare by the steam road. Cars will be run every fifteen minutes.

CHESTER, PA.—The managers of the Wilmington City Railway Company have decided to build the trolley line between Chester and Wilmington over the route of the Philadelphia & Wilmington Turnpike Company, and a survey will be made at once.

SYRACUSE, N. Y.—Representatives of the Syracuse, Moravia & Skaneateles Railroad Company have been visiting land owners along the proposed route and obtaining consent to cross their property. No opposition was met with. Work will be begun next fall.

TAUNTON, MASS.—Abbott P. Smith, the local promoter of the New Bedford, Middleboro & Brockton Street Railway, says that his company has not retired from the field, but has suspended operations awaiting the decision with regard to the franchise which has been asked for.

NORTHAMPTON, MASS.—The time limit fixed by the highway commission for the construction of an electric road on Bridge Street, from Day Avenue to the Hadley Bridge, by the Northampton & Amherst Company, has been extended one year. The original date was July 1 this year.

HARTFORD, CONN.—The Middletown Street Railroad has been granted permission to extend its line from Middletown to Crystal Lake Park. Negotiations with the owners of the park having fallen through, the company has acquired a fine grove just beyond, and will extend the line to that point.

BALTIMORE, MD.—The large car barn of the Consolidated Traction Company at Irvington, just within the city limits, was destroyed by fire on the evening of May 29. About 100 winter cars and other apparatus were also consumed. The barn was built about two years ago, and was a model structure of its kind.

NEW YORK, N. Y.—The Jersey City Street and Water Board have adopted an ordinance allowing the Grove Street line to change from horse to overhead trolley power. This is the last horse car line in Hudson County. The mayor vainly insisted upon 5 per cent. of the gross receipts or $1,000, but the company refused to pay either.

BRIDGEPORT, CONN.—All the obstacles in the securing the right of way from Stratford to Shelton by the street railway company have at last been removed. The one citizen who held out so long has surrendered. It is probably too late, however, to begin work this season, as it could hardly be completed in time to reap any advantage from the summer's profits.

NEW BRUNSWICK, N. J.—The officials of the Brunswick Traction Company are making arrangements for the erection of another car house and storage battery station about 3 miles from New Brunswick. The storage battery will be connected with the power house at Milltown, and will supply current for the Metuchen route. A similar building will also be erected near Bound Brook to supply that branch with power.

WILKESBARRE, PA.—The management of the traction company has adopted another method in the matter of street car tickets. The company has discontinued the sale of books at $4 each, but instead will sell 100 loose tickets at $4.25. The same tickets may be used two or three together, while under the old rules the books were restricted to the purchaser and family. Two or three persons may contribute and buy 100 tickets, and then divide them among themselves. The traction company will sell lots of 500 tickets for $21. The new order will go into effect at once.

NEW YORK CITY.—A mortgage for $15,000,000 was recorded in Newark, May 26,. It was given to the Manhattan Trust Company, of this city, by the organized North Jersey Street Railway Company, which has absorbed the Consolidated Traction Company, and now controls nearly all the trolley lines of Northern New Jersey. This mortgage covers all of the company's property in Essex County, and is given to secure $15,000,000 of gold bonds for $1000 each for fifty years. The bonds are guaranteed for 4 per cent. per annum after May 1, 1899. The mortgage was signed by J. K. Corbiere, who was formerly president of the company, and is now a director, and by Wilbur F. Johnston, the newly elected treasurer, who was formerly secretary. The signers on the part of the trust company were Amos T. French, vice-president, and C. H. Smith, secretary.

Obituary Notes.

FRED. NOLL, city salesman of the Sprague Electric Company, New York, died at his home in Brooklyn on the morning of May 30, of Bright's disease. His remains were buried on June 1. Mr. Noll was well known in the electrical trade, with which he had been identified for many years. He was a Royal Arch Mason, and was thirty-six years of age at the time of his death. His untimely end will cause sorrow among his many friends.

CHARLES E. EMERY, a well-known consulting engineer, of New York, died at his home in Brooklyn, on June 1, at the age of sixty years. He was born in Aurora, N. Y., and in 1861 entered the United States Navy as third assistant engineer. He served under Admiral Farragut in all the operations on the Mississippi, and was promoted to second engineer in 1862. In 1867 he retired from the navy. Mr. Emery won the Tilford prize ten years ago for the best paper read before the British Society of Engineers, in London. He was a member of the American Institute of Electrical Engineers and ex-president of the New York Electrical Society.

Personal Notes.

MR. F. C. ARMSTRONG, who has for many years held the position of general agent at Toronto, Ont., of the Canadian General Electric Company, has resigned to accept a similar position with the well-known English engineering and constructing firm of Dick, Kerr & Co., London, England. Mr. Armstrong will look after the selling business in the electrical department of the company in Great Britain.

MR. FRANK S. HASTINGS, well known from having for many years been prominently identified with the General Electric Company, as an officer and director, was seriously injured on Decoration Day at his residence in

Greenwich, Conn., by an explosion of acetylene gas, by which his summer home is lighted. Mr. Hastings was thrown 20 feet by the explosion and badly burned, but is recovering from his injuries. One side of the building was also blown out.

LEGAL NOTE.

APPLICATION WAS MADE before Judge Lacombe, of the United States Circuit Court, for the Southern District of New York, by the Consolidated Car Heating Company, for a preliminary injunction against the Gold Car Heating Company and the Gold Street Car Heating Company, restraining the latter companies from manufacturing or selling their new style electric heater. On May 26, Judge Lacombe handed down a decision requiring the defendants to give bonds in the usual form until November 1. The Gold Companies state that they will continue the sale of their improved heater and will protect purchaser. They feel confident that the court will ultimately decide in their favor.

TRADE AND MISCELLANEOUS PUBLICATIONS.

THE THOMSON ELECTRIC WELDING COMPANY, Lynn, Mass., illustrates and describes, in a recent catalogue, its apparatus for electric welding, tempering, annealing, brazing, forging and shaping of metals. The many advantages of electric welding are conspicuously brought out. A table is given showing metals, alloys and combinations of different metals actually welded by the Thomson electric process. This method of welding is already applied in various industries, including the manufacture of wagons and carriages, bicycles, tools, wire, pipe and pipe bending and coiling, street railway work, chains, etc., etc.

THE KENNEDY VALVE MANUFACTURING COMPANY, New York, has just issued an illustrated catalogue and price lists, with tables of dimensions, of its varied line of high pressure valves and fittings, indicator devices, etc. Special attention is directed to the improved line of steam valves for extra high pressure and superheated steam. They are designed to withstand the hard service incident to plants carrying from 125 to 250 pounds pressure, and are made extra strong to resist the strains caused by expansion and contraction to which they are subject. Among the various articles illustrated and described in brief outline are double gate valves, wedge gate valves of different styles, standards for rising and stationary stems with or without indicators, valve indicator attachments and cast-iron fittings.

THE BULLOCK MANUFACTURING COMPANY, Cincinnati, Ohio, in a handsome catalogue just issued, gives some excellent illustrations of its varied line of apparatus. The right-hand pages contain illustrations of machines of distinctive types, accessories and parts. The apparatus thus illustrated includes multipolar belted generators of various capacities and speeds, engine-type generators in variety, ironclad ventilated armatures, motors of the standard type, ceiling motors, web press equipment, the type T controller, which is furnished in connection with all flat-bed printing press motor equipments and motors for machine tools. The illustrations are of an exceptionally fine character and the catalogue is a work of art throughout. Specifications of each machine are given on the page facing the illustration.

Trade and Industrial Notes.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, advises us that it is receiving a large number of suggestions of names for its new lamp, and as each suggestion must be accompanied with an order, the company is correspondingly busy. Some of the names are of a character to provoke mirth.

THE SWETT & LEWIS COMPANY, No. 11 Bromfield Street, Boston, Mass., has accepted the selling agency of a well-known make of Faradic batteries, which, though of excellent construction and efficiency, are sold at a very reasonable price. The company's Bulletin No. 23 contains a full description of these batteries.

THE ANCHOR ELECTRIC COMPANY, Boston, Mass., has just brought out a full line of all-porcelain Westinghouse and T-H attachment plugs, which are very desirable novelties. The cap will accommodate a large flexible cord, and is held to the base part of the plug by a single screw. The annoyance resulting from the loss of the screw is obviated in the Anchor plug by holding the screw from dropping out by means of a little nut on the inside. The T-H plug embodies some novel methods of construction, which, it is stated, leaves little to be desired in this respect.

THE MILLER-KNOBLOCK COMPANY, South Bend, Ind., is rapidly coming to the front in the business of manufacturing assembled commutators, refilling commutators of all descriptions and rewinding armatures of all types. Its electrical department has been established only eight months, yet is doing work for a large number of the most prominent street railway and lighting companies in the country. The company's admirable business methods, together with excellent material, workmanship and prompt service, are the secrets of its rapidly increasing popularity. Mr. A. W. Morrell, the superintendent of the electrical department, has had fifteen years' experiences in this class of work.

AMONG THE LATEST APPLICATIONS of electric power is in the line of lumber mill machinery. The Westinghouse Electric & Manufacturing Company is installing for the Berlin Mill Company, of Berlin, N. H., two 180-kw, 400-volt generators, with a large equipment of its type C induction motors, for driving, planing and grist mills, machine shops and for lighting the plant. The installation is especially interesting as illustrating the use of alternating apparatus for short distance transmission, the extreme distance of any motor from the generator not exceeding 350 feet. Another electrically equipped lumber mill supplied by the Westinghouse Company is that of the M. G. Shaw Lumber Company, of Bath, Me.

THE BRYANT ELECTRIC COMPANY, Bridgeport, Conn., is erecting a new two-story power house 50 feet square. The building has brick side walls, and the framework is of steel skeleton type. The floor of the building is supported on heavy girders and columns, which carry steel joists supporting corrugated iron arches and concrete floor. The roof has clear span trusses carrying corrugated iron covering, lined with patent anti-condensation roof lining, which prevents the condensation of moisture on the under side of the roof covering, and avoids any damage or inconvenience from moisture dropping on the delicate machinery or material on the floor below. This building was designed and the steel material furnished and erected by the Berlin Iron Bridge Company, East Berlin, Conn..

MESSRS. ZIMDARS & HUNT, 127 Fifth Avenue, New York, have just issued a new catalogue dealing exclusively with panel, feeder and distribution boards. The catalogue very completely covers this line of apparatus, and will no doubt be of value to contractors and engineers especially and to the trade generally. About all the types of panel and feeder boards anyone can have use for are found illustrated and listed in a systematic manner. Dimensions are given of all boards listed, and this feature will prove of value to the contractor who has heretofore been compelled to guess at the probable sizes of the boards he contemplates using. Half-tone illustrations show very clearly all the distinctive features of the various types. The cover is in imitation of marble, with copper embossing and is a work of art. A copy of this catalogue, which is entitled Catalogue B, may be obtained by addressing the firm.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has recently completed a novel electric plant for the Fletcher Manufacturing Company, of Providence, R. I. This latter firm is over 100 years old. The original Fletcher manufactured shoe strings and sold them for wheelbarrows. The concern is now one of the most successful in Providence, employing about 600 hands, making shoe strings, lamp wicks, etc. Until recently two engines were used by this plant, one on each side of the street. Desiring to shut down one of them it was found impossible to run a shaft under the street, but permission was secured to lay electric wires. The single engine will now operate the entire plant, by running a 150-kw, 400-volt, two-phase Westinghouse generator, which transmits current across the street to a 200 horse-power type "C" motor. The motor is left connected with the generator most of the time, thus enabling the two plants on the two sides of the street to start up together.

AMONG THE RECENT ORDERS received by the Walker Company may be mentioned the following: One 250-kw belted railway generator and four double 4-A-S-1000 railway equipments, for the Holland (Mich.) & Lake Michigan Railway Company; one 50-kw direct connected lighting generator for Russell & Co., Pittsburg, Pa., to be shipped to Sewickley, Pa.; one 250-kw belted generator for Norton & Taunton (Mass.) Street Railway Company; one 30-kw direct current generator, ordered by S. M. Fischer, Chicago, for the Patton Motor Company, same place; one 30-kw generator for W. A. Johnson Electric Company, Toronto; one 200-kw direct current generator for Lewiston Electric Light Company, Lewiston, Idaho; two 225-kw belted railway generators for the Wheeling & Elm Grove Electric Railway Co., Wheeling, W. Va.; United States Ordnance Department, six 10-inch disappearing gun carriages for coast fortifications. The following orders for foreign shipment have been received: Edgar C. Moxham & Co., New York City, for Manaos Railway Company, Brazil, three 130-kw direct current railway generators; through agents in Japan, Messrs. Bagnall & Hilles, Yokohama, one 75-kw railway generator and switchboard apparatus and two double railway motor equipments, of 3-S-800 motors; through the London agency, fifteen double equipments of 33-S-800 motors and type SL controllers; two 120-kw railway generators, with switchboard apparatus; five double railway motor equipments of 3-N-800 motors.

THE THERMO-ELECTRIC COMPANY, of New York, has just been organized to manufacture and sell the improved Cox thermo-electric generators under the exclusive license from the patentee. Col. Augustus G. Paine is the president of this company. Colonel Paine is the president of the New York & Pennsylvania Company, which operates large paper and pulp mills; a director of the Mercantile National Bank, the New York Life Insurance Company and many other prominent companies. The general manager of the Thermo-Electric Company is Mr. L. S. Langville, a gentleman of decided ability and an untiring and persistent worker. Mr. Langville's proven ability as a manager of many large and successful companies augurs well for the success of this new thermo-electric generator, which is already meeting with large sales. Mr. M. J. Wightman is the consulting electrical engineer of the company and Mr. Otto Rothenstein is the superintendent of its new and complete factory in Brooklyn, which is turning out these thermo-electric generators in constantly increasing quantities to meet the growing demand. This type of generator is claimed to be perfectly adapted for the running of electric fans, for operating local telegraph sounders, electric bell installations, phonographs and for electro-plating. These generators are being extensively used for charging storage batteries for use by dentists and for use in operating automatic pianos, X-ray apparatus, etc. Their field of utility is practically unlimited wherever a small and constant source of current is necessary. In the company's New York office, No. 102 Times Building, there is a perfectly equipped laboratory, in which is shown some of the many uses to which the thermo-electric generator can be adopted, and would be well worth the time of anyone, who is interested to drop in and see for himself this little generator at work.

Business Notices.

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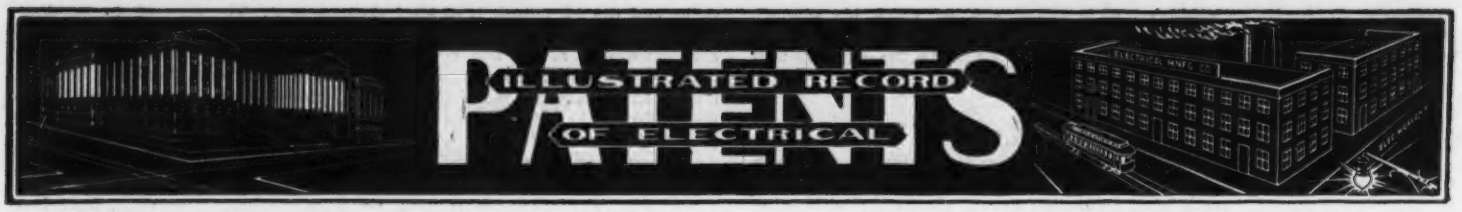
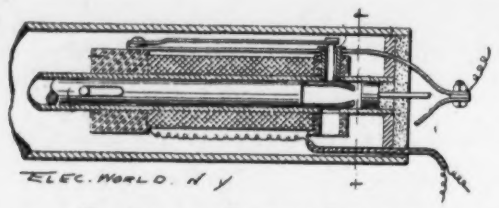


UNITED STATES PATENT ISSUED MAY 24, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

604,544. ELECTRICAL GOVERNOR; M. A. Replogle, Akron, Ohio. App. filed Feb. 19, 1897. In combination with an electrical governor having a pair of electromagnets, a pair of insulated electrical contact points by means of which electrical circuits may be completed through the said magnets, the said insulating contact points being separately adjustable and jointly movable.



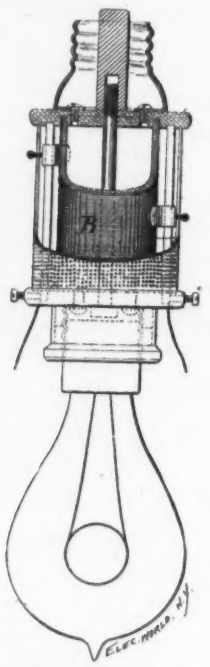
No. 604,747.—Electric Railway.

UNITED STATES PATENTS ISSUED MAY 31, 1898.

604,712. ELECTRICAL SIGNALING SYSTEM AND APPARATUS; W. F. Banks, Milford, Conn. App. filed Oct. 1, 1896. This invention relates to electrical signalling systems and apparatus, and has for its object to produce a signaling system and apparatus whose operation shall be positive and certain.

604,747. ELECTRIC RAILWAY; J. H. Guest, Boston, Mass. App. filed Oct. 20, 1896. The combination with the through shaped contact rail forming a working conductor, supplemental contact rails or conductors within the same, metal cross pins or bars mounted in the sides of the trough and passing through said rails, but insulated from them, and a filling of insulating cement or concrete in which the rails and pins are anchored.

604,770. PNEUMATIC ATTACHMENT FOR TELEGRAPH KEYS; W. J. Lieb, Pratt, Minn. App. filed April 15, 1897. A pneumatic attachment for telegraph keys, comprising an outer wall, a diaphragm, means for securing



No. 604,949.—Rheostat for Electric Lamps.

the device to a key button ,and a tube leading into an air chamber formed by said outer wall and said diaphragm.

604,806. ELECTRICAL BELT; A. J. Taylor, Vineland, N. J. App. filed April 12, 1898. An electrogalvanic belt, consisting of a sheath, hook plates attached thereto, a battery detachably connected to said hook plates within the sheath and battery electrodes arranged outside of the sheath, and electrical connection with the hook plate in the battery.

604,842. ELECTRIC MOTOR OR DYNAMO; A. L. Riker, New York, N. Y. App. filed Nov. 24, 1897. This invention relates to the construction of electric dynamos or motors, and particularly to motors used for propulsion of vehicles, which are entirely inclosed in a casing, which also forms the frame of the machine.

604,843. FORMER FOR WINDING ARMATURE COILS; A. L. Riker, New York, N. Y. App. filed Nov. 19, 1897. A coiling frame or former comprising two parts having a winding space between them, and grooves or winding channels in each part transverse to the plane of the winding space, those in one part being on the face of the former, and those in the other part in the rear thereof.

604,866. SIGNAL FOR ELECTRIC RAILWAYS; W. H. Jordan, Brooklyn, N. Y. App. filed Feb. 16, 1897. This invention relates to signals for electric railways, and the object is to produce a simple arrangement and mechanism for operating signals at street crossings, although the invention is equally applicable for other purposes.

604,874. SAFETY DEVICE FOR ELECTRIC CARRIAGES; R. T. D. Brougham and W. C. Bersey, London, England. The combination of a closed box, a keyhole leading into the box, two open contacts within the box remote from the keyhole and connected to the circuit wires, and a key so shaped that it passes through the keyhole, and when the key is turned connects the contacts.

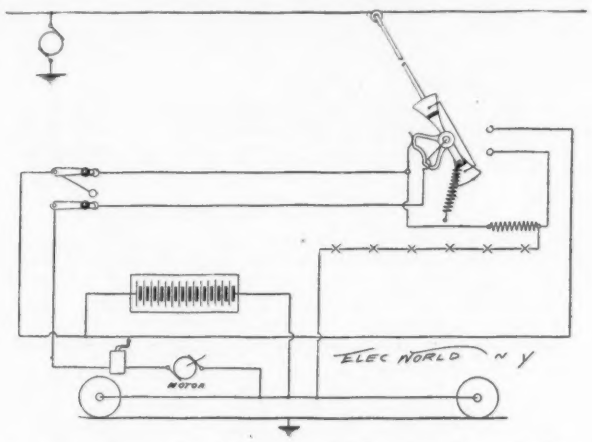
604,911. ELECTRIC RAILWAY; F. D. Sweet, Elyria, Ohio. App. filed Nov. 4, 1897. This invention relates to a combination of devices whereby the electric current generated at a central station is conducted to a traveling motor car.

604,949. RHEOSTAT FOR ELECTRIC LAMPS; R. H. Wappler and F. H. Wappler, New York, N. Y. App. filed Sept. 20, 1897. This invention relates to a peculiarity in the rheostat whereby a large resistance is concentrated into a small space, and the risk of heating or injuring is reduced to a minimum, and the circuit connections are arranged with reference to diverting any desired proportion of the current into a shunt or derived circuit, and for regulating the current flowing through the incandescent electric lamp, and thereby determining the luminosity of the same.

604,968. AUTOMATIC CURRENT DISTRIBUTER FOR ELECTRIC RAILWAYS; J. Claret and O. Vuilleumier, Paris, France. App. filed May 4, 1897. This invention consists of certain improvements in the construction of automatic distributers for electric railways of the character described in patentees' former patents.

605,013. SWITCHING DEVICE AND CIRCUIT ARRANGEMENT FOR ELECTRICALLY PROPELLED VEHICLES; E. B. W. Reichel, Berlin, Germany. App. filed Jan. 10, 1898. In a trolley switching device, the combination with a trolley arm, contact piece electrically connected with and actuated by said trolley arm, and contact part adapted to be electrically engaged by said contact piece only when the trolley arm is in engagement with the trolley conductor.

605,023. ELECTRIC SWITCH FOR USE WITH ELECTRICALLY PROPELLED VEHICLES OR LOCOMOTIVES, ETC.; A. T. Snell and C. E. Grove, London, England. App. filed Oct. 8, 1897. This invention consists in the construction and use of a compound switch or series of interlocked



No. 605,013.—Switching Device and Circuit Arrangement for Electrically Propelled Vehicles.

switches, especially adapted for controlling four electric motors, but applicable also with simple modifications to the controlling of groups of two, three or more electric motors.

605,066. THIRD RAIL UNDERGROUND ELECTRIC RAILWAY SYSTEM; L. E. Walkins, Springfield, Mass. App. filed Aug. 21, 1897. In a third rail electric railway system, the combination with the track rails and the top slotted conduit, of the cross ties, supported within the conduit above the base thereof, the trough of wood, mounted on said ties and longitudinally extending, a rail set in the trough, and filling of insulating material provided in the trough, and covering the base and neck of the rail, the upper portion of said rail extending above said filling of insulating material, which is downwardly and outwardly inclined from its junction with the exposed portion of the rail.